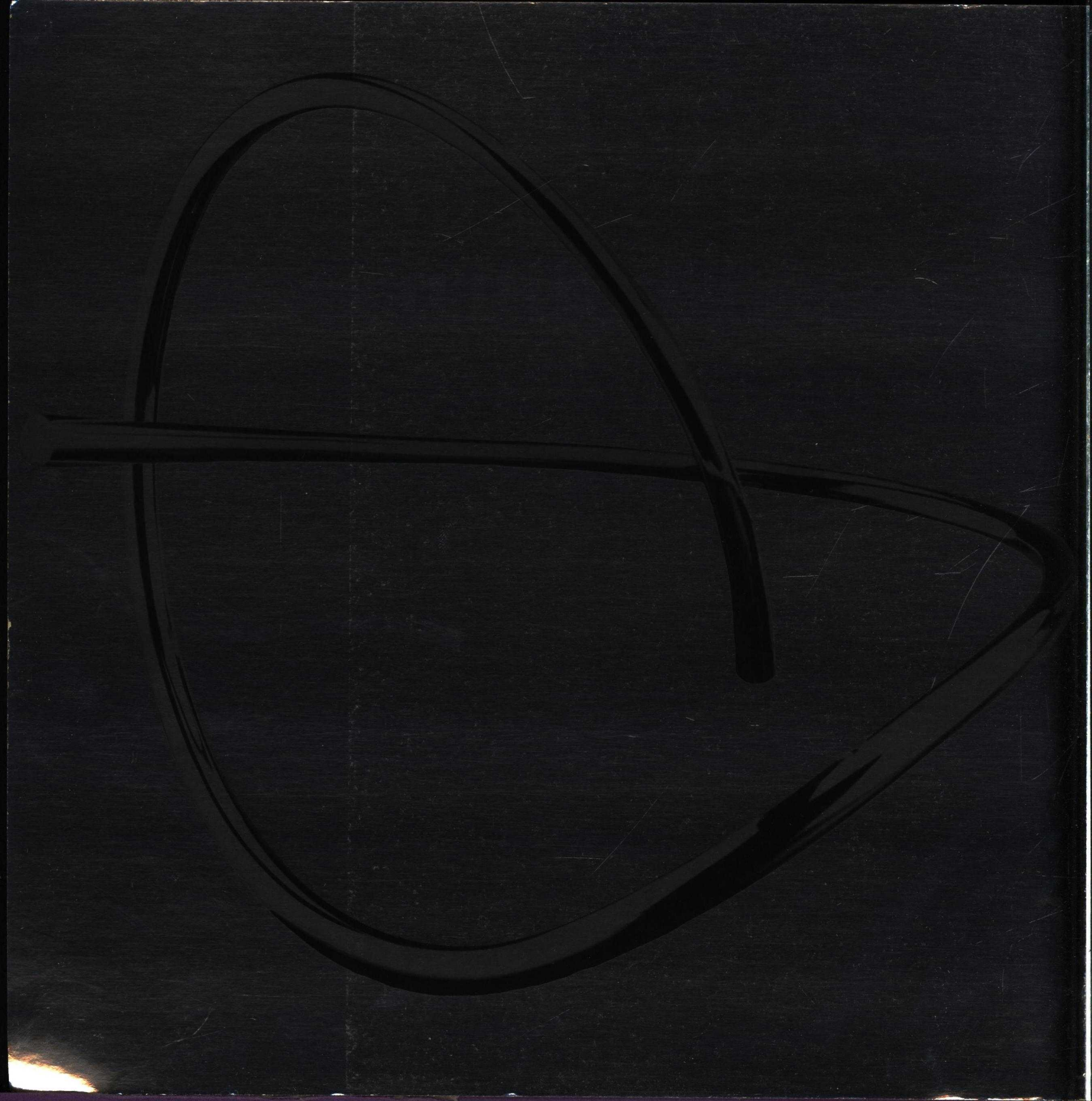
Aluminum in Modern Architecture '60



Aluminum in Modern Architecture

'60

over photograph shows the Sidney Meyer Music owl in Melbourne, Australia, selected by the merican Institute of Architects as the 1959 R. S. eynolds Memorial Award Building.

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An International Review of

Aluminum in Modern Architecture

1960 Edition

Companion to **Aluminum in Modern Architecture**

Volumes I, II, and 1958 Supplement

'60

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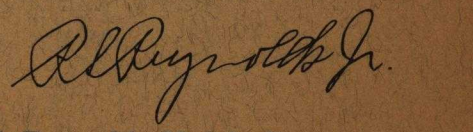
Foreword

This is the second supplement to the books, "Aluminum in Modern Architecture", published by the Reynolds Metals Company just four years ago. It is one of our continuing efforts to keep you up-to-date with the uses of aluminum in building which have been increasing at such an unprecedented rate.

This International Review, which features both the 1958 and 1959 winners of the R. S. Reynolds Memorial Award selected annually by the American Institute of Architects, recognizes the fact that many world-famous and nationally renowned architects were among the first to realize the unique properties of aluminum as a building material and to employ it in some of their most celebrated works of architecture. It is, like the awards, an acknowledgement of the debt the aluminum industry owes to the creative imagination of these men who use aluminum with a beauty and variety that constantly amazes even its producers.

This book presents evidence of the rapid gains which aluminum is making as a really modern building material; not only for monumental and industrial construction, but also in homes and multiple unit residences. We at Reynolds are confident that aluminum will win even greater prominence in the building field, as architects and builders continue to work with aluminum fabricators to develop new applications for the versatile metal.



President, Reynolds Metals Company

Introduction

It is in keeping with the accelerated technological development of our times, that aluminum has in just a decade become a standard part of the vocabulary of modern architecture. It is also in keeping with this continued development that new aluminum uses, which are more economical, efficient, and attractive, are constantly appearing.

As in preceding editions, Aluminum in Modern Architecture, 1960, presents a review of buildings gathered from all over the world, which exhibit the latest inventive and proficient use of aluminum. In making our selection, the editors are fortunately aided by the R. S. Reynolds Memorial Award made each year by the American Institute of Architects for the most outstanding use of aluminum in building. In this edition, two prize winning buildings introduce a group of some twenty-six current examples of aluminum in architecture. The section closes with two recent buildings erected by the Reynolds Metals Company—the Reynolds General Office Building in Richmond, Virginia, designed by Skidmore, Owings & Merrill, and the Reynolds Great Lakes Sales Region Headquarters Building in Detroit, Michigan, by Minoru Yamasaki. These two works are included not only because they quite naturally contain imaginative use of aluminum, but because they also represent the endeavor of the company "to practice what it preaches" by securing finest architectural design for its own building program.

This edition also includes a technical section where twelve questions about corrosion, generally conceded to be one of the most misunderstood subjects in modern building, receive answers by a panel of aluminum experts. Albert M. Cole, former Federal Housing Administrator of the U. S. Government, follows with a report on aluminum in housing, the light construction phenomenon of the last few years. Cartoonist Robert Osborn contributes an original portfolio of his favorite architectural types. Heads of architectural departments in four leading American universities, José Sert of Harvard, Paul Rudolph of Yale, Ralph Rapson of Minnesota, and Paul Schweikher of Carnegie Institute of Technology, discuss the future of aluminum and architecture.

The bibliography for further reading and the comprehensive index at the back of this edition have been compiled in the hope that this supplement will find a convenient and useful place on your shelf alongside Aluminum in Modern Architecture, Volumes I, II, and 1958.

Aluminum in Modern Architecture

The twelve architects and engineers below share one of the most distinguished honors in modern architecture. They are winners of the R. S. Reynolds Memorial Award selected each year by the American Institute of Architects for "the most significant contribution to the use of aluminum, aesthetically or structurally, in the building field".

Shown in front of their Transportation Pavilion for the Brussels World Fair are the seven Belgian designers, left to right, R. Moens de Hase, H. Montois, R. Courtois, A. Lipski, J. Goossens Bara, Mr. T. Hoet-Segers with Mrs. F. Hoet-Segers in the foreground, who earned the 1958 award. Standing in front of their dramatic Sidney Meyer Music Bowl are the Australian architects, left to right, Roy Simpson, Balcombe Griffiths, Tom Freeman, Barry Patten, and John Gates, selected for the 1959 award. The $25,000 prizes and the emblematic sculptures designed by two of America's leading sculptors, José de Rivera and Seymour Lipton, awarded in successive years to architectural teams working some 12,000 miles apart, attest to the international character of the award. They are also evidence of the increasing world-wide use of this modern light metal. Information about these two prize winners as well as twenty-eight other recent buildings distinguished by outstanding use of aluminum is presented on the following pages.

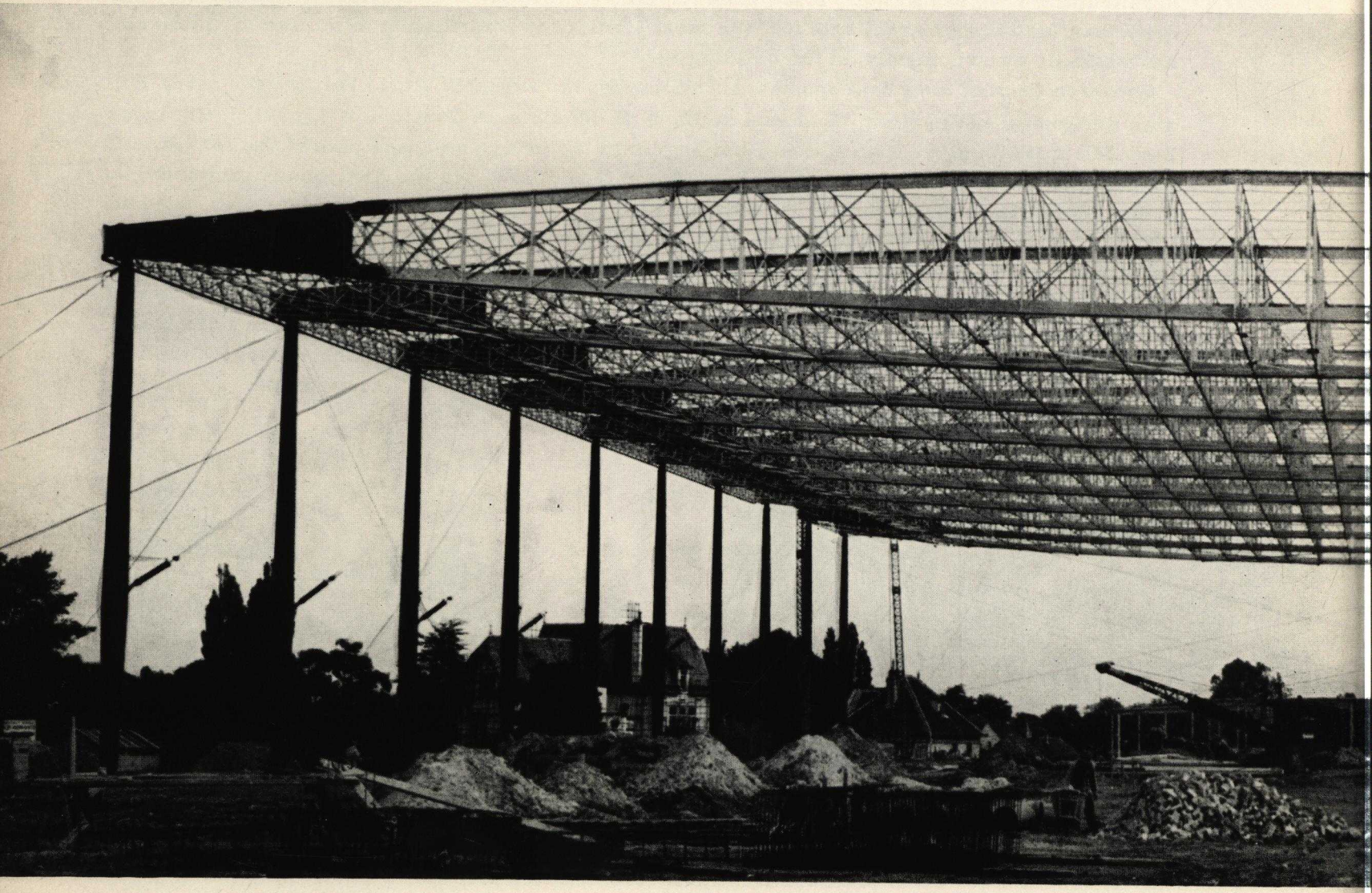
The Brussels World Fair Transportation Pavilion

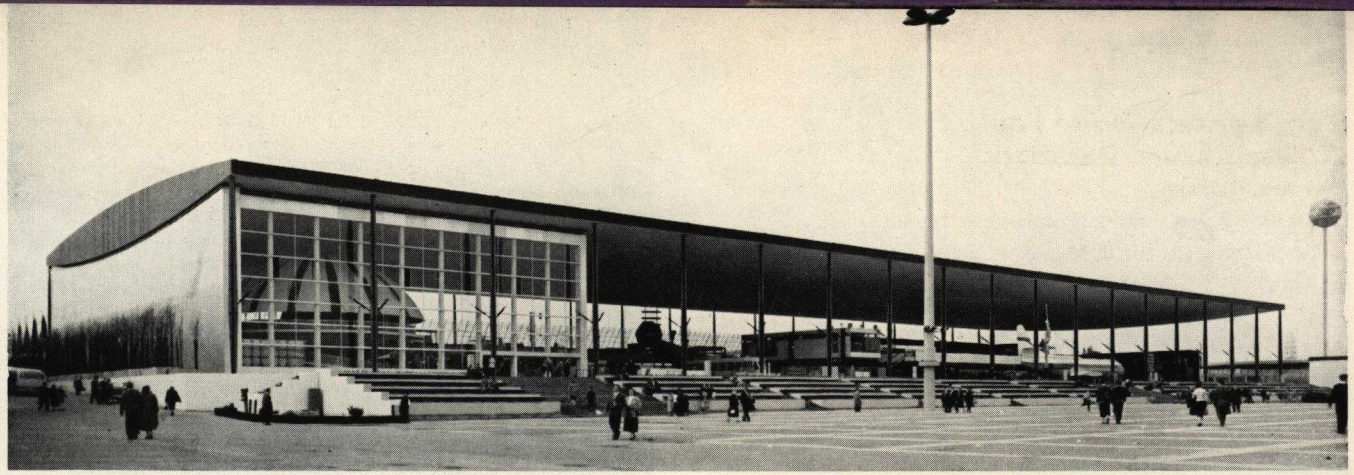
Brussels, Belgium

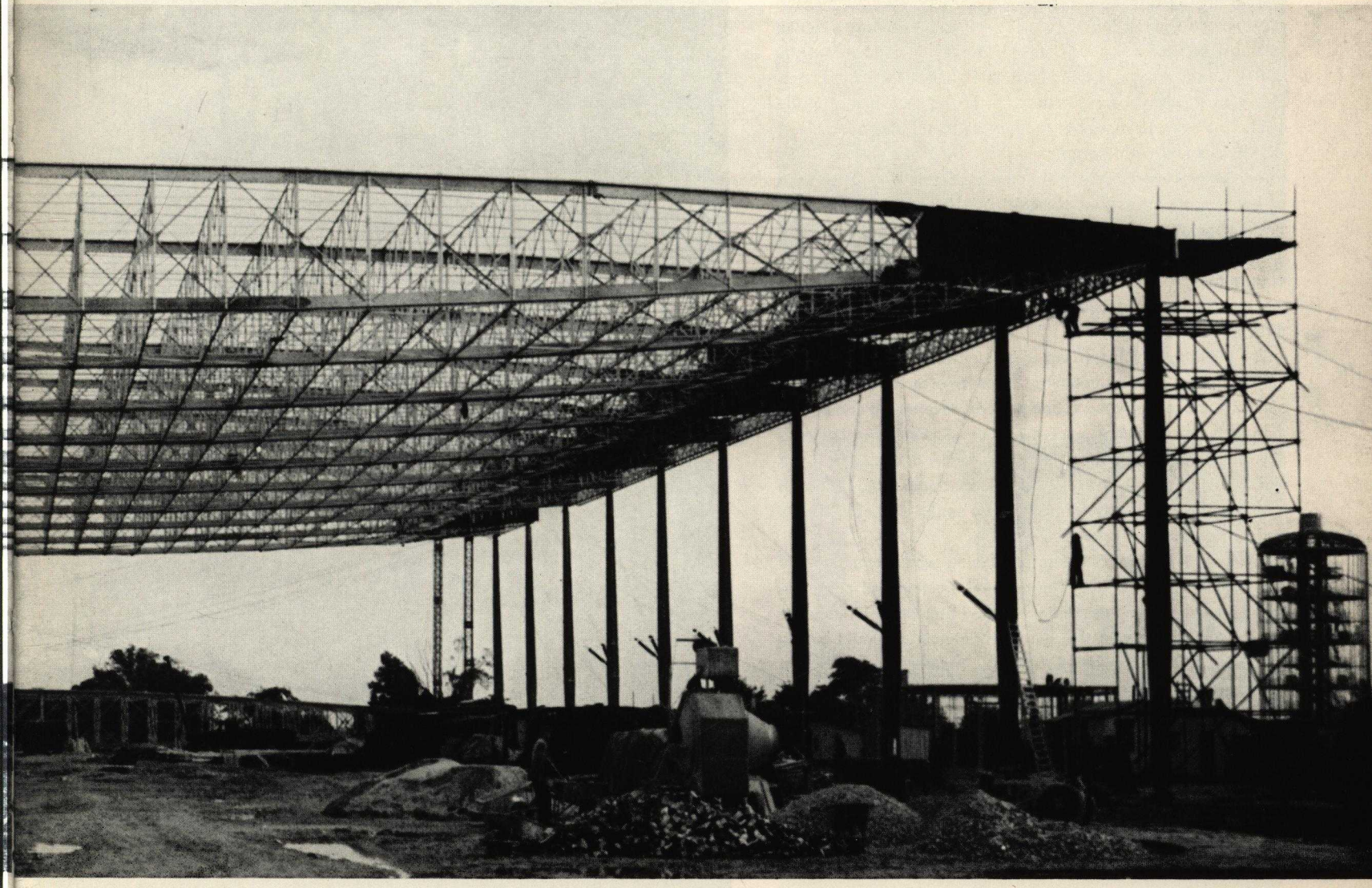
H. Montois & R. Courtois, T. & F. Hoet-Segers,

J. Goossens-Bara and R. Moens de Hase, Architects

Below This dramatic photograph of the 1958 R. S. Reynolds Memorial Award winner under construction reveals the lightweight roof structure which won the admiration of the jury. Nineteen aluminum latticed trusses are supported on 38 columns. Aluminum was judged the most appropriate material because of its lightness, freedom from maintenance, lack of corrosion, and ease with which aluminum roofing, fascias, and soffits could be attached. **Right** The light look of the structure was skillfully preserved in the completed building. One end of the open-air pavilion is protected by screening walls of aluminum and glass. The fact that these walls were not required to be complete, weatherproof enclosures allowed an unusually elastic structural design. The great 644 x 227-foot curved roof seems to float unencumbered above the pavilion's colorful transportation exhibits. This imaginative design concept was enhanced by a keen attention to detail that gives this building a simple elegance, remarkable in exhibition architecture.



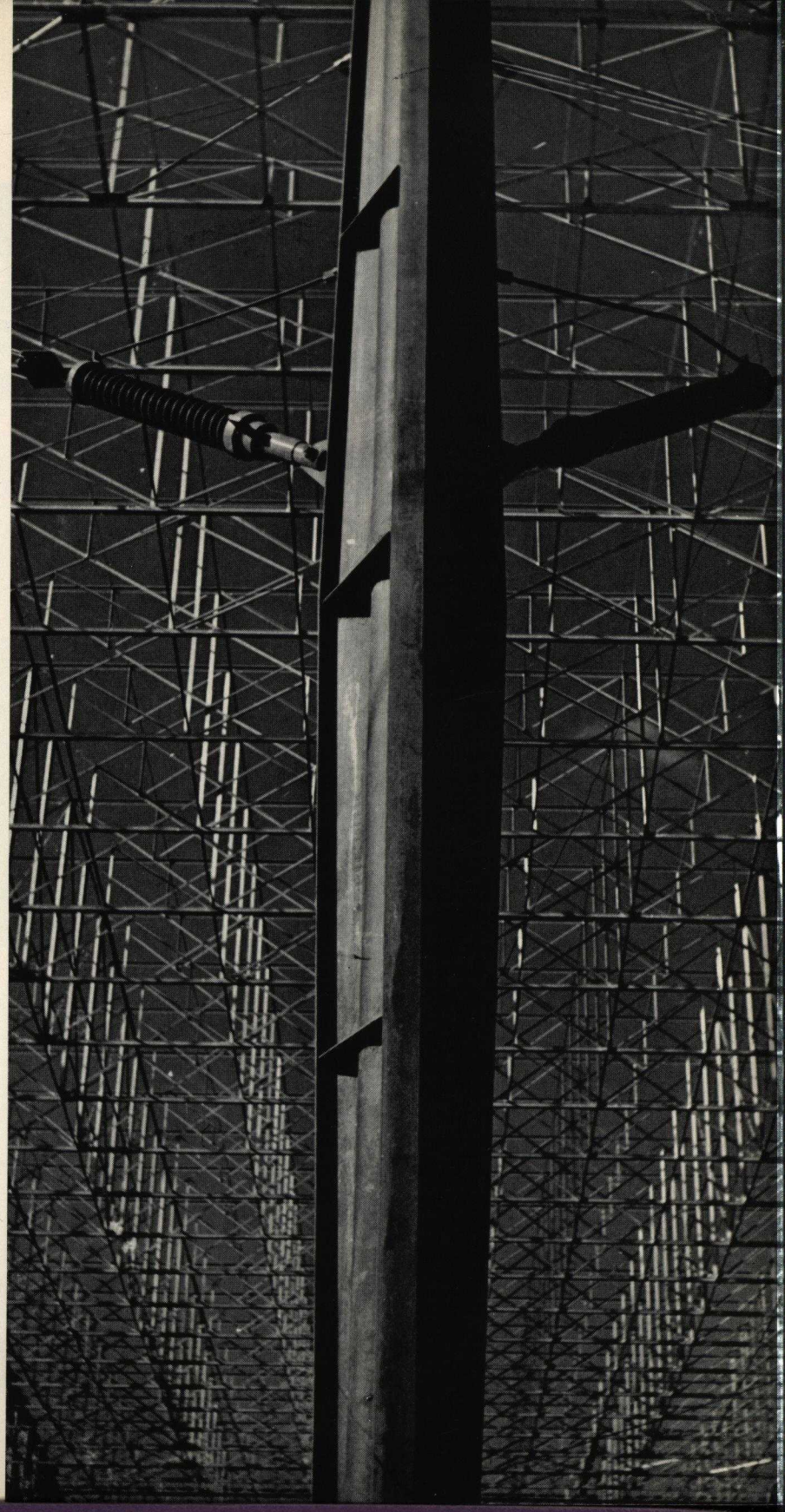


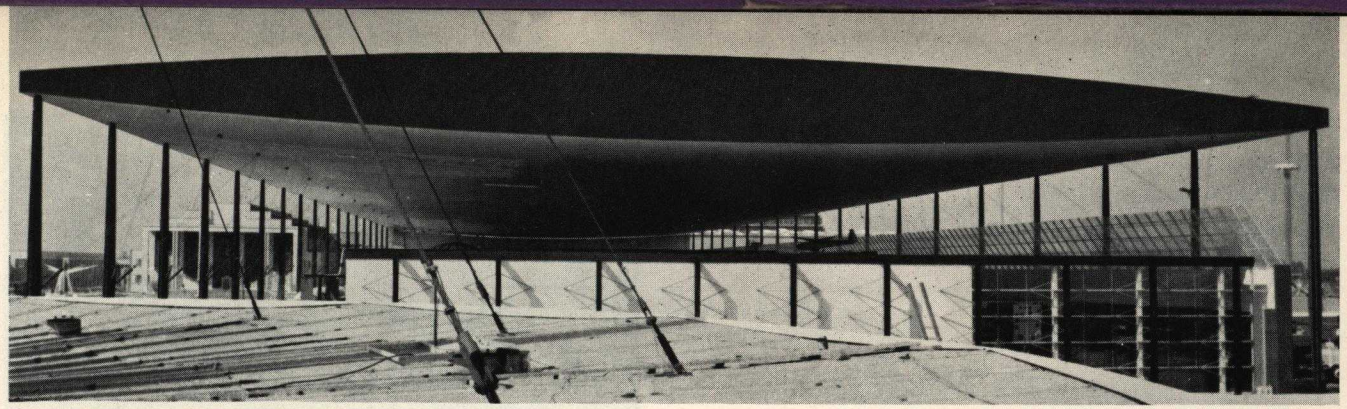


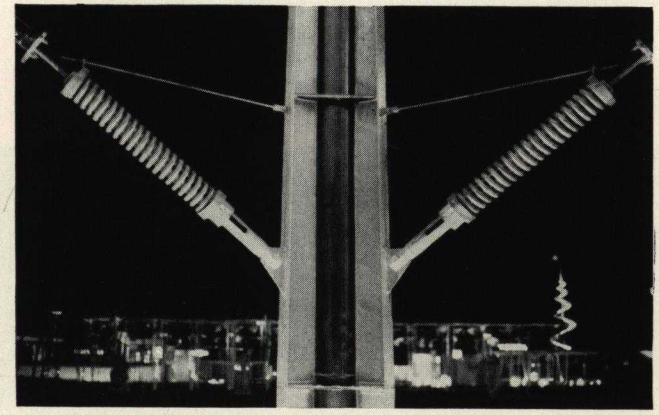
"Once more this work places in great evidence the indissoluble tie which united the architectural aspect and the structural substance." So remarked Italy's famed Pier Luigi Nervi, member of the distinguished R. S. Reynolds Memorial Award Jury which included Chairman Arthur Loomis Harmon, Richard J. Neutra, J. Roy Carroll Jr., and Richard M. Bennett. Discussing the Transportation Pavilion, he continued, "In effect, the finesse of the posts, the expressiveness of the form in the double parabola of the trusses and the covering, and the feeling of elegance which forms the most remarkable characteristic of this work, have been possible only as the result of the original solution of the tie-rods in permanent tension which connect the posts and the trusses. This solution resolves in a most elegant way the difficult problem of permitting thermal expansion and contraction and of preserving the necessary stability in either transverse or longitudinal direction."

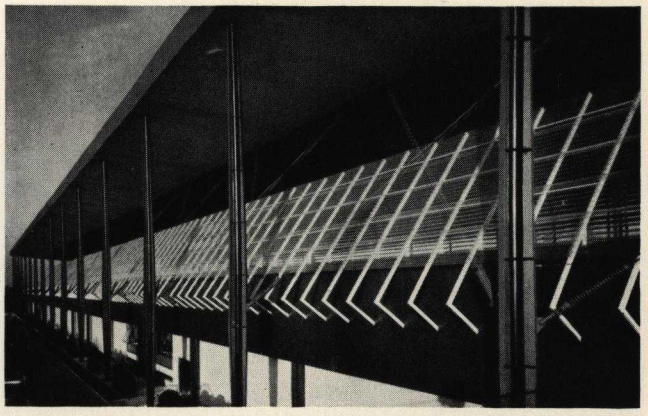
The building, which appears as an airy weightless roof poised lightly on two rows of columns, consists of aluminum trusses similar to those employed in bridge work, covered top and underside with corrugated aluminum roofing. The tapered columns like the one shown on the right, are specially designed of tubes and T-sections. They are hinged top and bottom. Movement of the structure is carefully controlled by a series of special cables and tension springs.

However, in selecting the prize-winning work among the 60 submissions nominated by the national architectural organizations of some 14 countries and the United States, the jury sought to honor designers who through use of aluminum would endow their structures with aesthetic qualities transcending structural values. The Transportation Pavilion was outstanding because it matched structural imagination with aesthetic judgment. The building was as elegant in detail as it was unusual in total concept. Aluminum was used handsomely as well as functionally to express the theme of modern transportation. The Transportation Pavilion of the Brussels World Fair translates into modern architectural language the concept of space as the true domain of transportation.

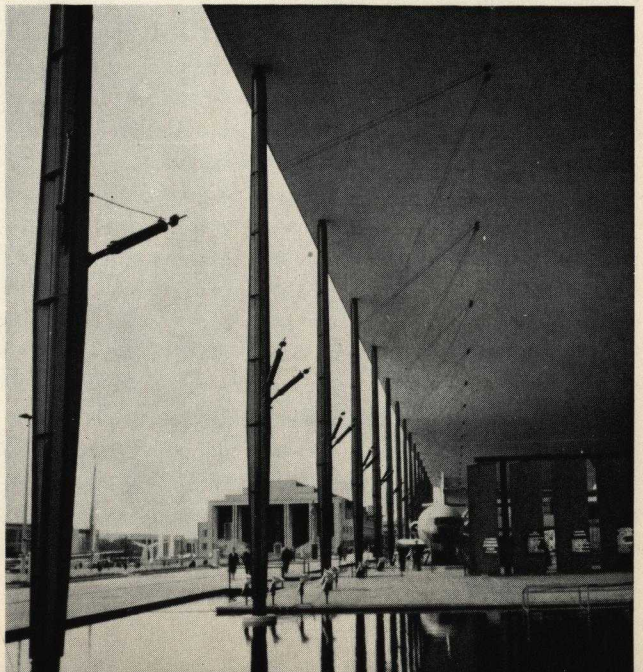






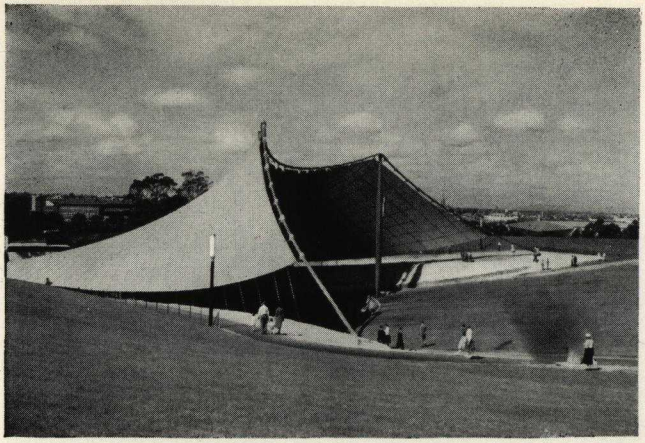


Left Column is made of steel tube to which three T-sections have been added at each 120-degree point. **Top** Construction photo shows the completed roof. **Middle left** Those tension springs attached to each column act to stabilize the structure. **Middle right** Horizontal translucent louvers protect the northwest side from the weather. **Below left** This photo shows the weblike aluminum truss structure. **Below right** The building was planned to accommodate unusual exhibition needs like the pool for water transportation and full-size aircraft for aviation display.



Sidney Meyer Music Bowl

King's Domain
Melbourne, Australia
Yuncken, Freeman Brothers, Griffiths & Simpson, Architects
with Barry B. Patten, Chief Architect

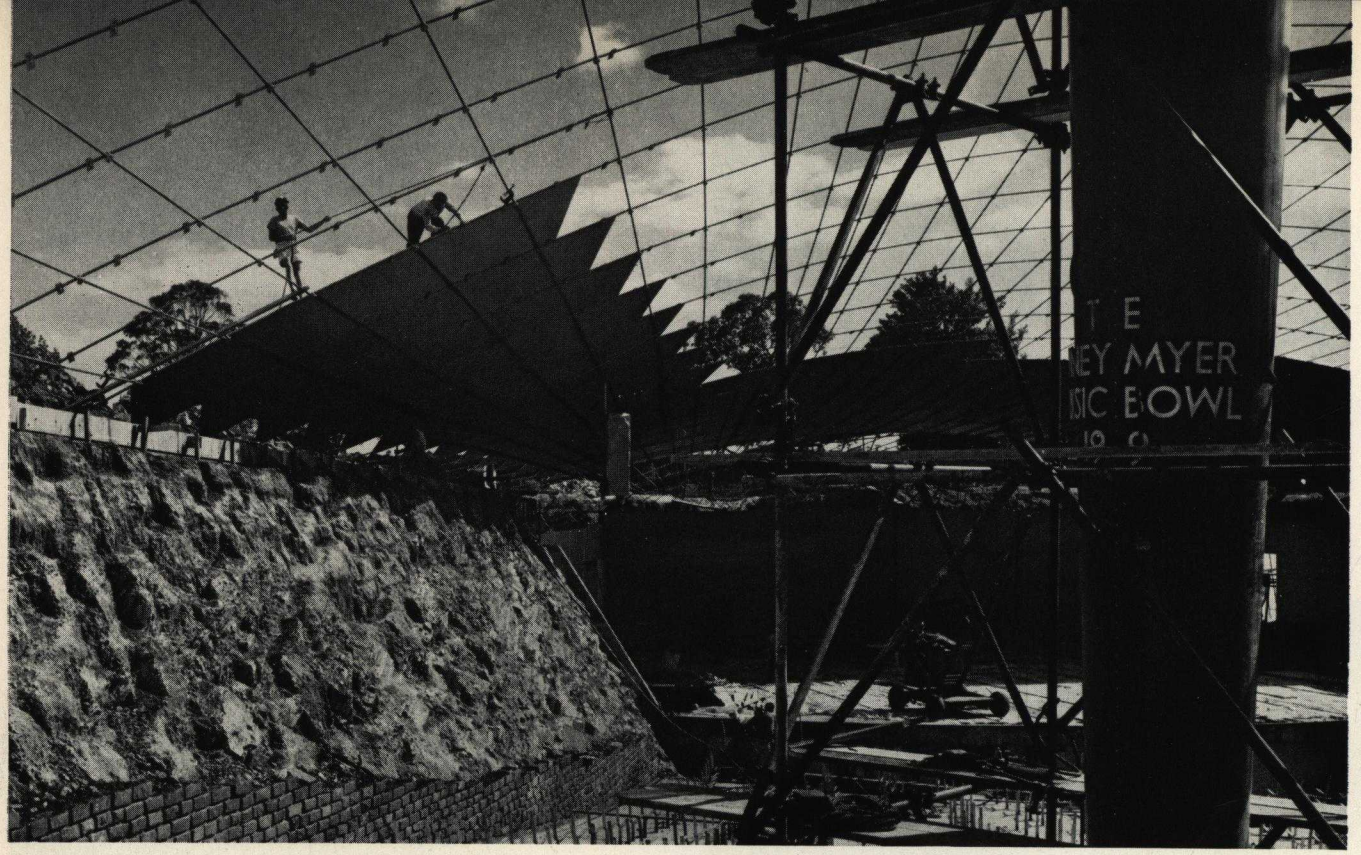


This music bowl located in Melbourne, Australia, was selected by the American Institute of Architects as the outstanding aluminum building of 1959. It was produced under circumstances familiar to architects all over the world – a tight budget and a tight timetable. With a remarkable combination of engineering invention and designing skill, Yuncken, Freeman Brothers, Griffiths & Simpson, with Barry B. Patten as designer, converted these all-too-familiar problems into an architectural triumph.

The jury, John Noble Richards, Carlos Contreras, William Caudill, Eero Saarinen, with Robert E. Alexander as Chairman, passed over many entries of formal and classic beauty to enthusiastically select this dramatic structure, "in which," reports the jury, "aluminum is not used as ornament, but as an intrinsic element of shelter and acoustic reinforcement."

The architects selected aluminum for the roof covering for the following abundant reasons: low initial cost, combined with minimum maintenance; ease of handling, particularly the ability to fix readily from above without scaffolding; suppression of external noises, combined with acoustical reflective properties to highest concert hall standards; non-drumming in rain; the ability to withstand winds up to 80 miles per hour; and permanent good appearance in the attractive park setting. In using the aluminum to face plywood sections, the designers developed a complete skin vocabulary; that is, the skin, its connections, and its fabrication method. This aluminum sandwich applied to a cable frame is a significant contribution with application far beyond this specific problem, in the opinion of the jury. While many drawings and diagrams of what such shapes might be have been published, few proposals have solved the most difficult problem – the skin itself. This the prize winners have accomplished with utmost simplicity and ingenuity to create a graceful structure for the enjoyment and education of the community.

Far Left The Sidney Meyer Music Bowl's unique form was developed from the need to convert the gently sloping lawn of a city park into an amphitheater and to protect it from the noise of traffic. The solution combined excavating and banking the earth with construction of an acre-size umbrella of aluminum to create an "orchestra shell" of enormous proportions. **Left** This construction photograph shows the huge web of roof cables. **Below** Nighttime lighting makes the bowl a setting for music.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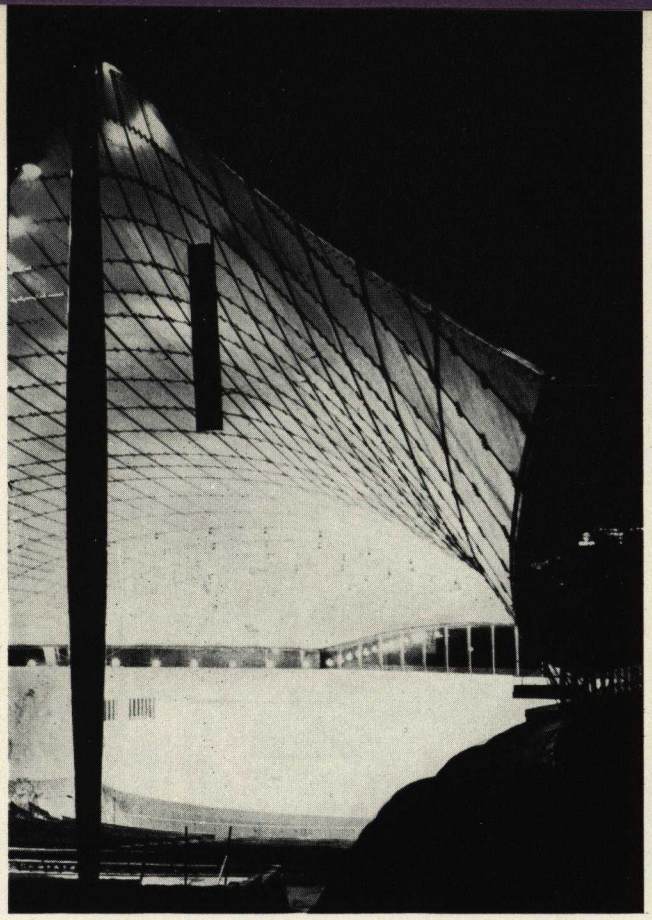
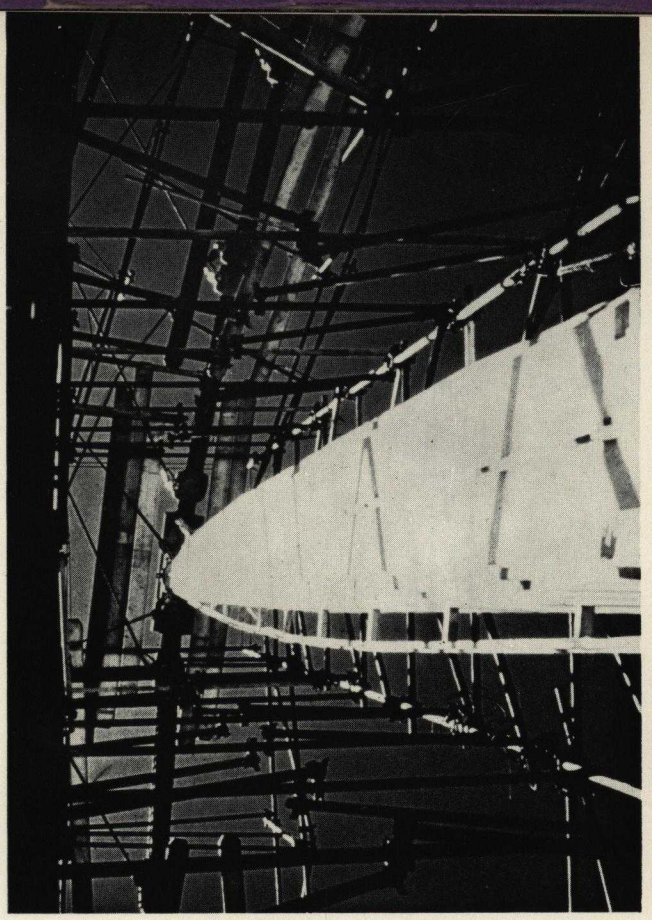
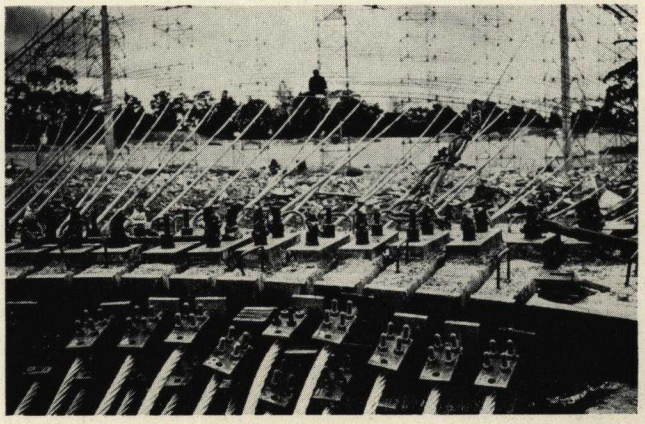




Far left top Workmen attach roofing to the cable webbing. The roof covering consists of marine-grade plywood faced on both sides with 26-gauge aluminum to form sheets 25 x 7-foot x ½-inch thick. Satin-finish aluminum sheets are bonded to the core with a special formula of tissue glue, joints on weather faces being welded. Bonding takes place in hot presses where heat expansion in the skins tends to place the core in a pre-stressed state of compression. **Far left below** This night view shows the relationship between the brightly lit bowl and nearby street traffic, so important from an acoustical standpoint in determining the design. Banked earth and the curved roof keep out interfering noise from the street. **Top left** The 72-foot fabricated steel masts covered with fiberglass sheathing in a cigar shape support the main cable. **Bottom left** Over 15,000 feet of galvanized wire rope were used to construct the roof webbing. **Top right** Special equipment helped erect the 40,000-square-foot canopy. **Bottom right** Thirty-five longitudinal cables running north and south are fastened to reinforced-concrete anchor strips buried in the ground.



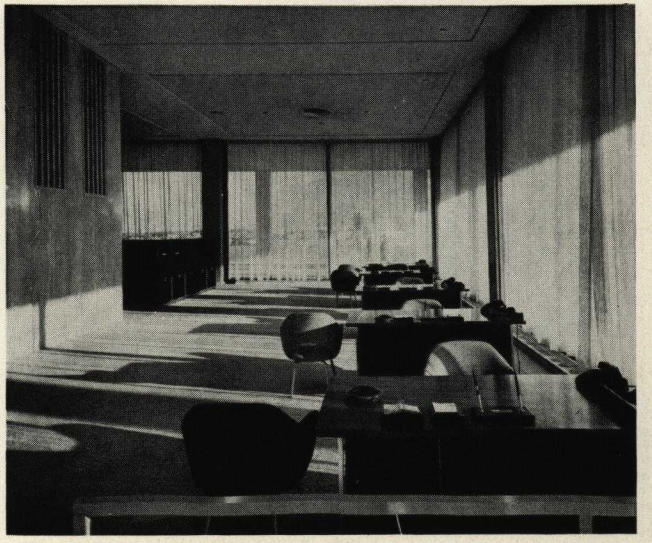
Franklin National Bank

Roosevelt Field Shopping Center, Nassau County,
Long Island, New York
I. M. Pei & Associates, Architect, with Pershing Wong, Designer
and George T. Maros, Coordinator
George A. Fuller Construction Co., General Contractor

Above The main building facade has a massiveness appropriate to the flat site. The gold anodized aluminum sunshades, a close-up of which is shown left, fit directly over the windows to provide protection and texture.

Below The glass and aluminum bank offices, recessed within the ground floor columns, have black anodized aluminum structural frames and gold column covers. Curtains and illumination control window glare.

Here is a handsome bank with a sense of fitness that is as noteworthy as its sparkle of originality. It was the first building to use a completely gold anodized aluminum exterior. It also has the first nondirectional shading device. As efficient as outside louver screens, the sunshade saves enough on the air-conditioning load to make an extensive induction air-conditioning system economical. It is made of $\frac{3}{4}''$ x $\frac{1}{16}''$ interlocking aluminum slats tabbed into aluminum channel frames. Sunshades, mullions, grids, column covers, window frames and glazing beads, penthouse louvers, copings and component parts are all gold anodized aluminum. This one-color, flat-surfaced facade would be almost monotonous if surrounded by curtain-walled neighbors in a city environment. But in the neon carnival of irrepressible Long Island, it is completely appropriate. Its calm and precise design also gives it dignity. Pleasant landscaping, stylish aluminum street lights, splashing fountains, and amusing curved bank stations provide it with the right balance of gaiety and variety.

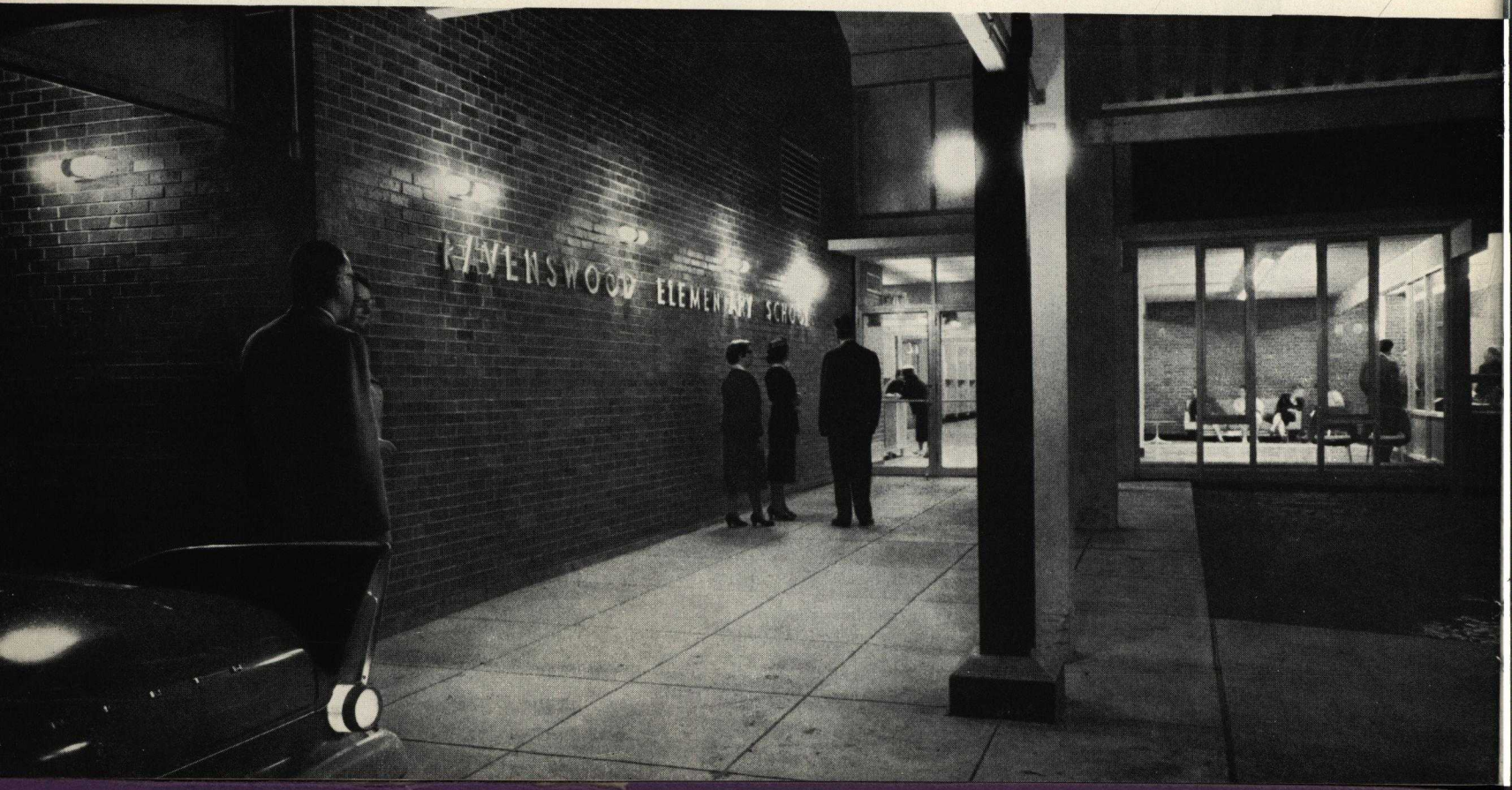


Ravenswood Elementary School

Ravenswood, West Virginia
Perkins & Will, Architects and Engineers
with C. E. Silling & Associates
Kuhn Construction Co., General Contractor

This attractive school is an answer by one of the nation's most celebrated school design teams, Perkins and Will, to an increasing critical problem . . . the need for a quality school designed for rapid construction to meet the demands of sudden increases in population. In this case, the desperate need for new facilities arose from local industrial plant expansion. It proved an opportunity to test wide use of aluminum building materials, furnishings, and equipment. However, the architects felt wherever aluminum was employed, it should be in conjunction with traditional building materials in a style appropriate to the community's existing architecture. The result is an unpretentious building fitting naturally into the countryside, demonstrating the adaptability and appeal of aluminum.

Consisting of twenty classrooms, the Ravenswood Elementary School is built with a precast concrete structure, porcelainized aluminum panels, and aluminum roofing. An unusual number of the interior furnishings and fixtures are also of aluminum. In the cafeteria, for instance, the tables, chairs, trays, and waste receptacles, as well as the legs and brackets on the counter, have been designed in aluminum to give the eating place an easily maintained, sparkling clean look. Six hundred pupils walk several times a day over the aluminum thresholds, grasp the aluminum hand rails, and wrap their legs around the aluminum desk and chair legs. This outstanding school is an example of the increasing use of aluminum in school construction. This is a field of important architectural design in which building materials must economically face not only the normal attack of weather, but also the steady wear of human use.

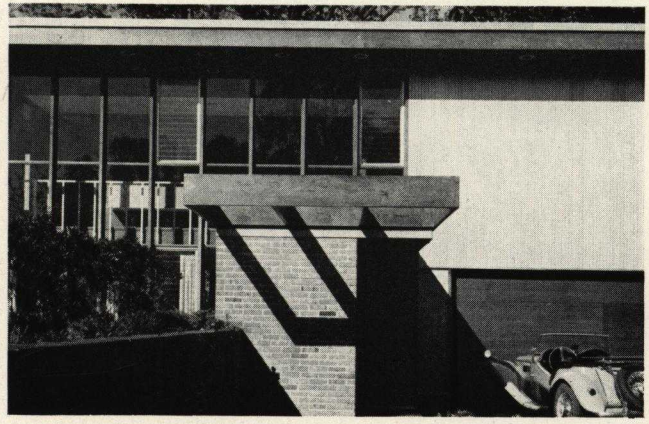


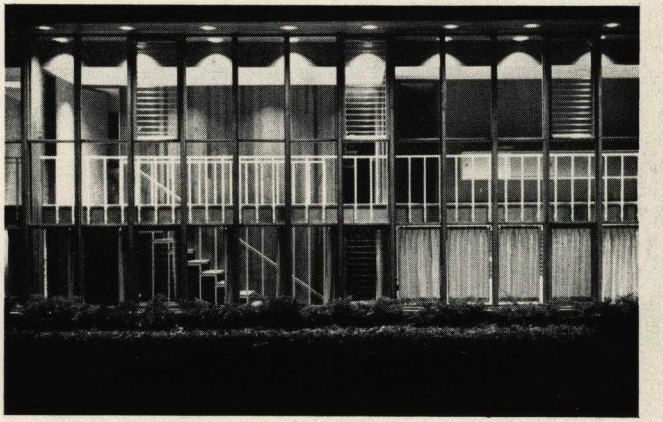
Far left The entrance to the Ravenswood Elementary School, lit up at night for a parent-teachers meeting, is made inviting by the openness of the aluminum and glass entrance. Crisply styled aluminum lettering and gleaming aluminum light fixtures contrast with traditional building materials. **Above** Located on an attractive natural site, overlooking the Ohio River Valley, this overall view of the building indicates the ease with which the school fits the landscape. **Below left** Neat details help make the school a model of educational design. Aluminum spandrels used on the exterior walls are ribbed and, with the vertical divisions of the aluminum windows, balance the long line of the school's plan. **Below right** The interior of the school shows the architects' careful attention to scale, relating the design to the size of the average student.

House for Mr. and Mrs. J. T. Kirkpatrick

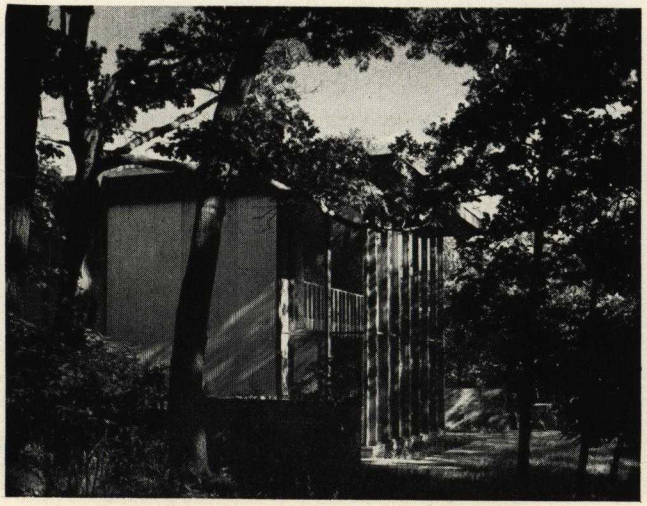
Kalamazoo, Michigan
George Nelson and Gordon Chadwick, Architects
John J. Meninga, Contractor

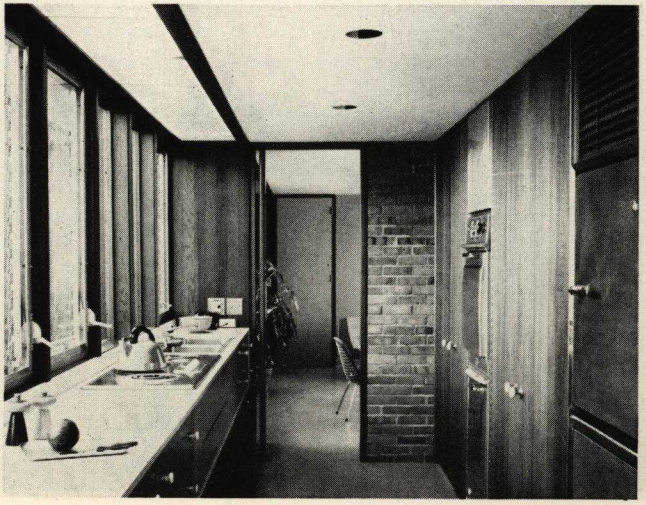
Dignity of proportion and a happy handling of light mark this exceptional house with its varied uses of aluminum. Corrugated aluminum panels are skillfully combined with traditional residential building materials to give the exterior a vertical texture balancing the horizontal lines of brick and wood. Bathrooms are finished from ceiling to floor in aluminum tile. With advantages of easy application, light weight and improved maintenance, this tile makes a particularly satisfactory choice from the designer's standpoint. Throughout the house, special attention is given to the use of light. Strip lighting with carefully positioned aluminum spotlights, softened and concealed by aluminum mesh, runs along ceiling edges in many rooms. In all cases aluminum was selected as much for its attractive appearance as for its notable residential practicality.

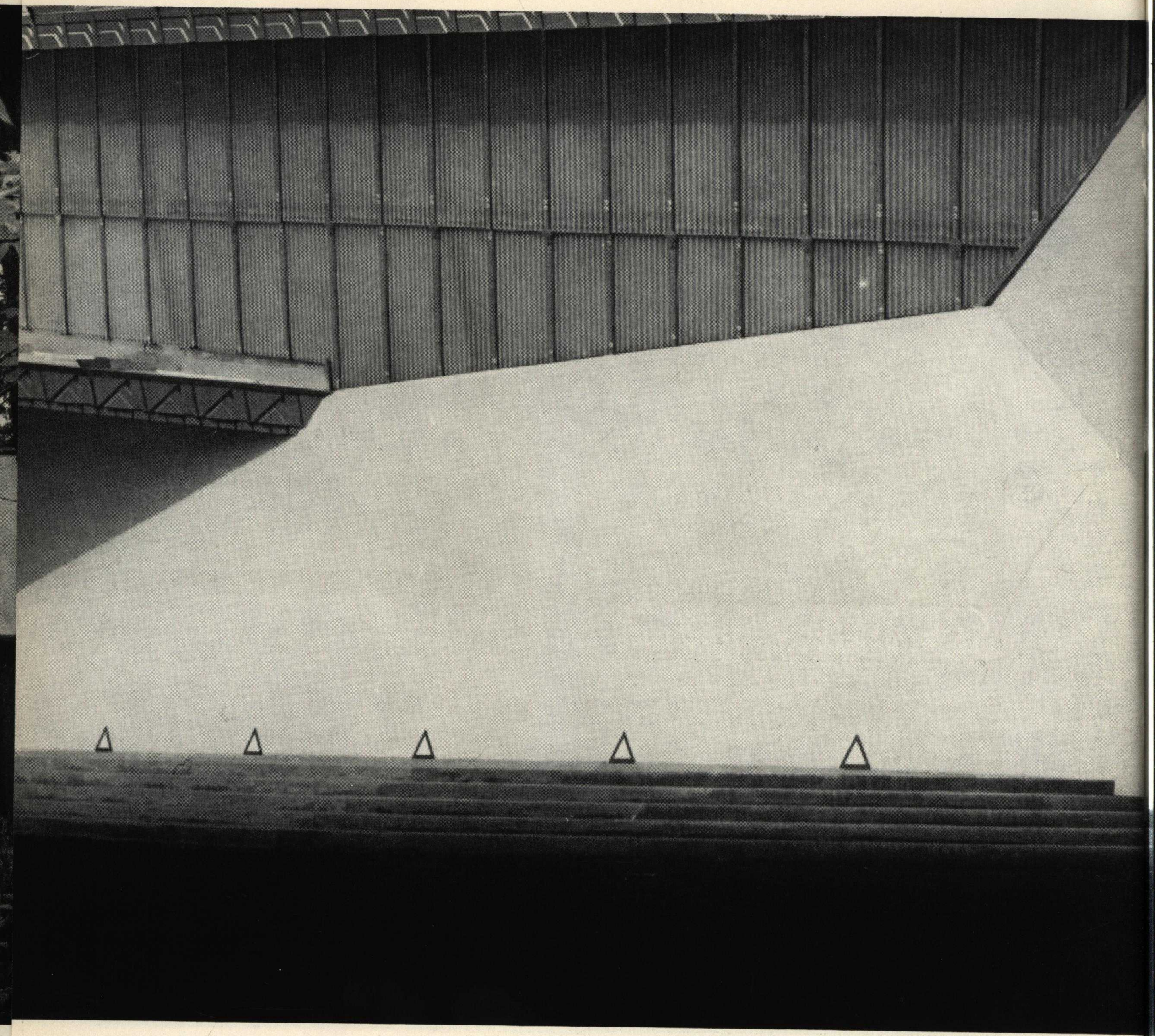


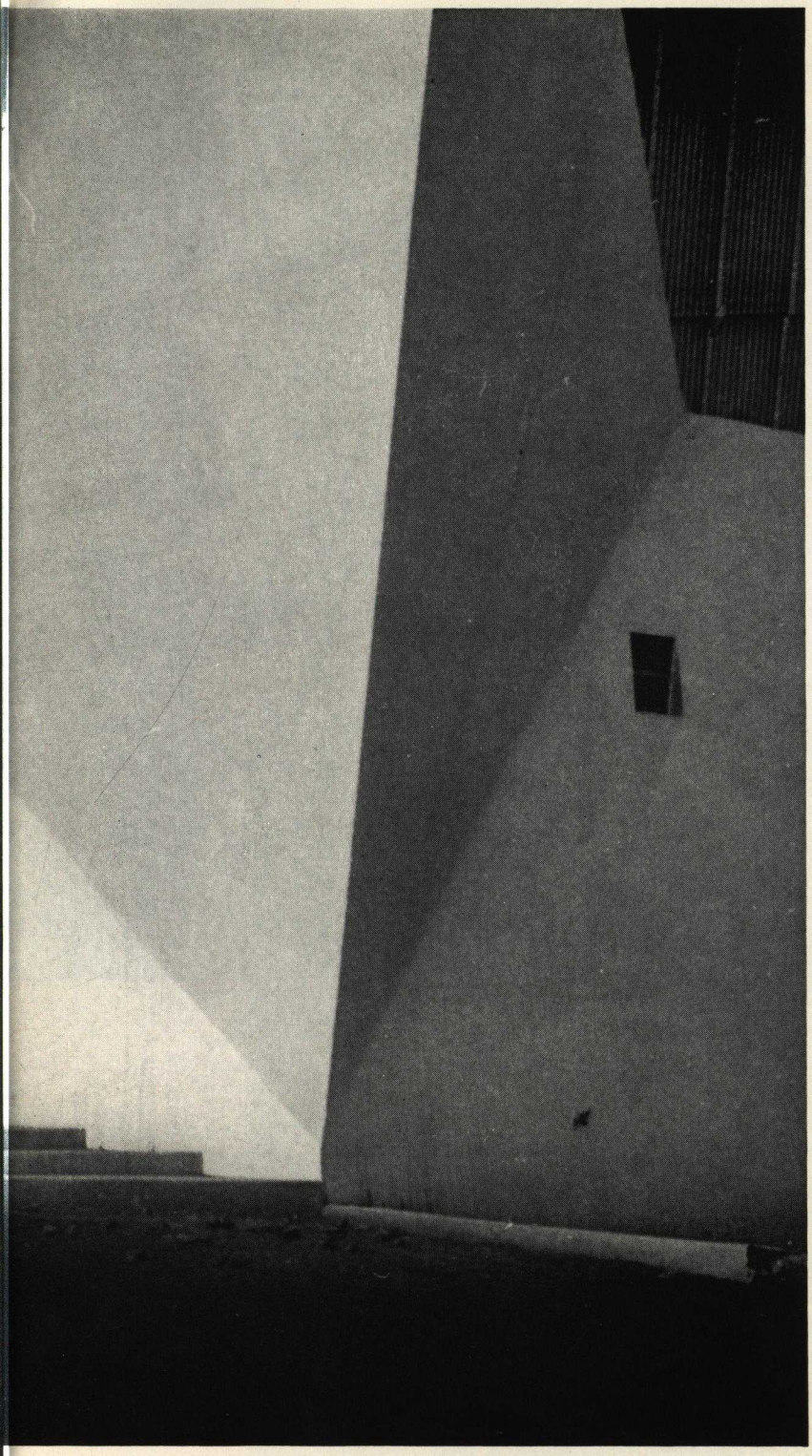


Left Corrugated aluminum paneling provides a contrast to regular exterior materials. **Above** Windows are aluminum framed. **Below** Side view shows large aluminum panel. **Above** Night view shows the facade's lights. **Below** Hexagonal aluminum mesh enhances ceiling lighting.









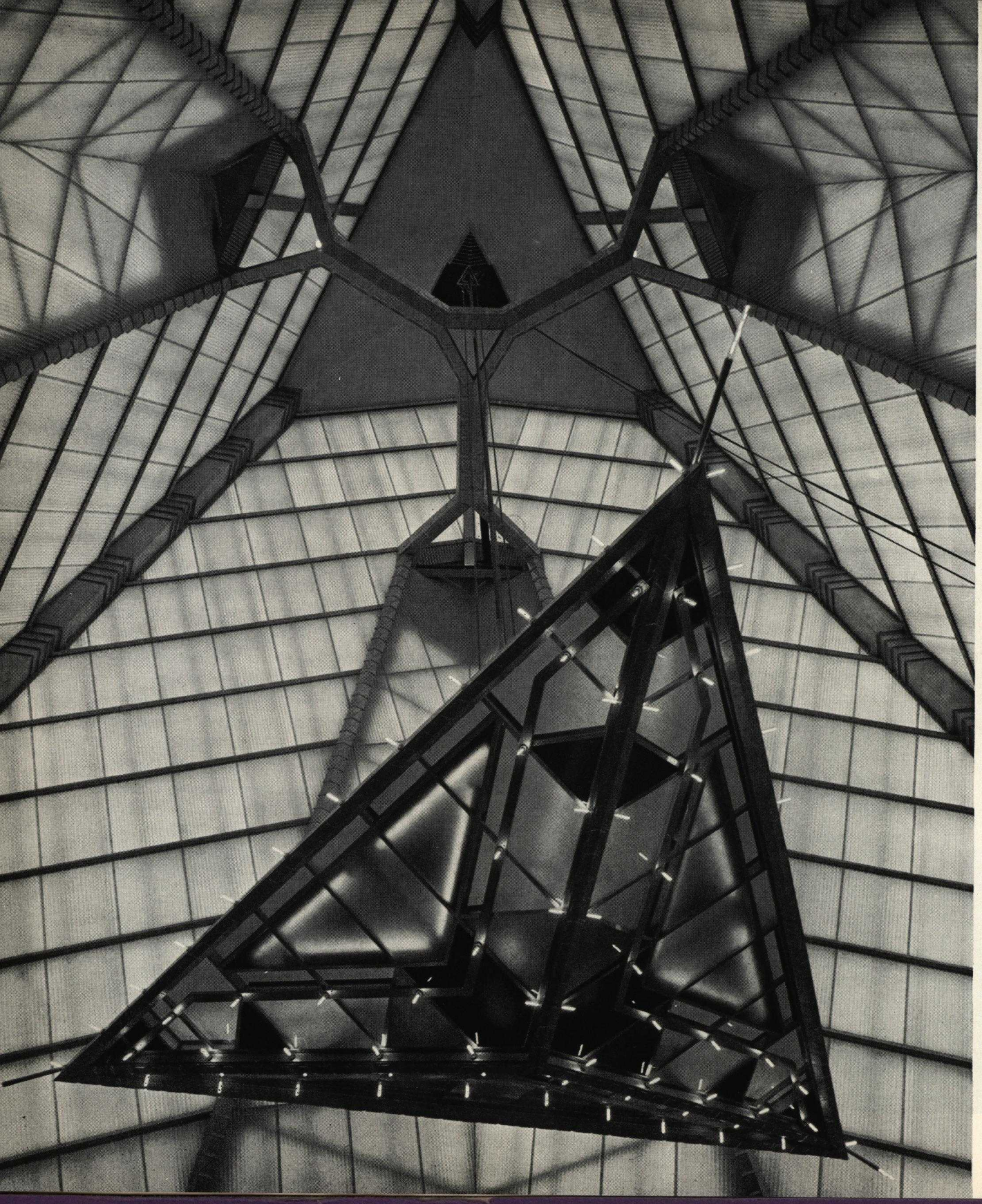
Beth Sholom Synagogue

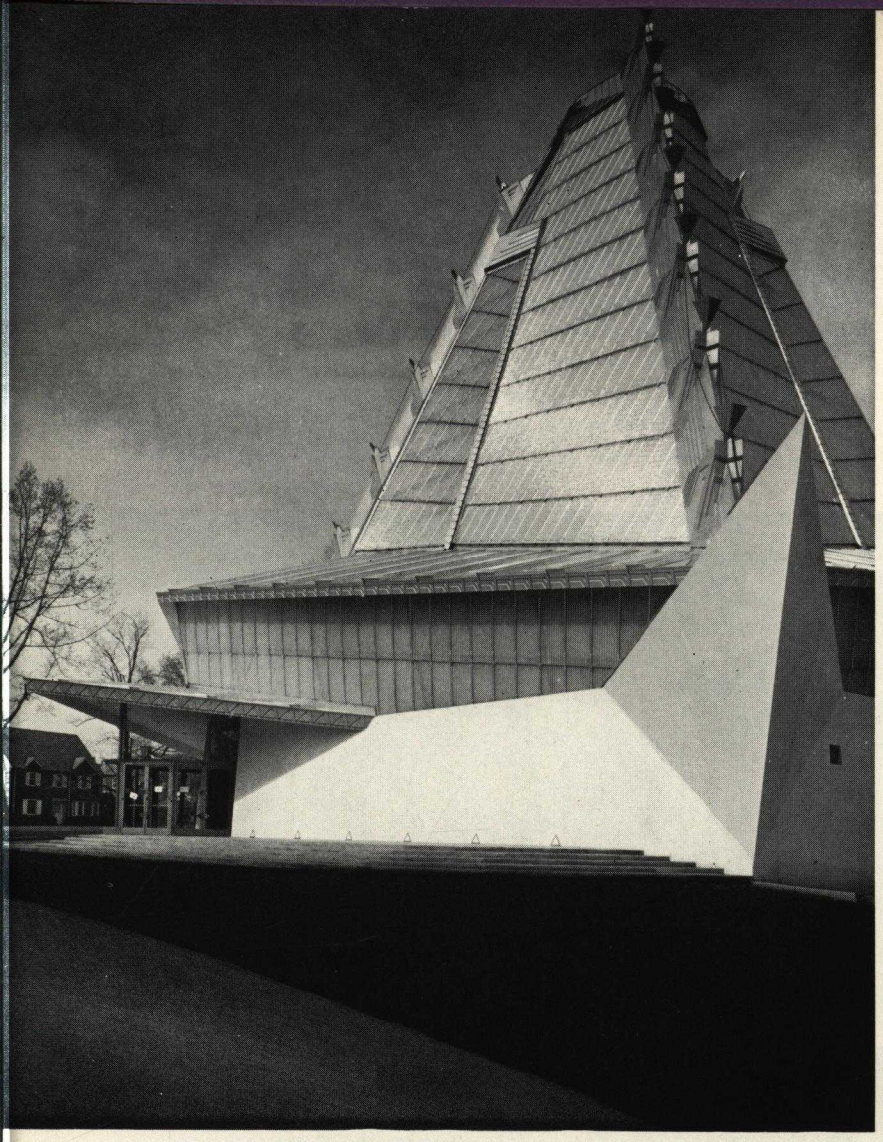
Elkins Park, Pennsylvania
Frank Lloyd Wright, Architect
Haskell Culwell Construction Co., General Contractor

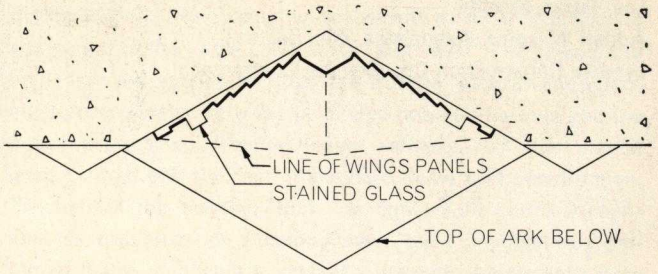
The late Frank Lloyd Wright filled this temple in suburban Philadelphia with the things that made his architecture great. He had typically clear-cut, bold ideas. The exterior was conceived as "a great symbol of Mt. Sinai–a mountain of light". Inside he sought "to create the kind of building that people, on entering, will feel as if they were resting in the very hands of God". Seen at night the great roof of white glass and silvery aluminum does indeed seem a glowing mountain of light, and the upper temple room with its floor sloping gently inward, does suggest restfully cupped hands.

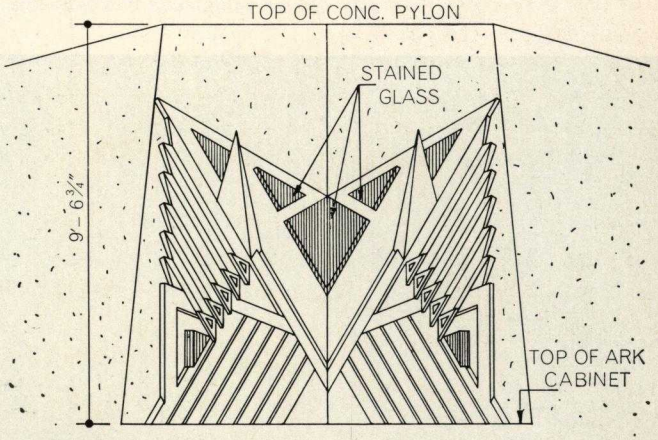
It is the mark of a great architect, however, that such aesthetic values are matched with extraordinarily skillful use of materials. In the Beth Sholom Synagogue, Wright employed the modern building material–aluminum, with the same sure hand with which he used the familiar concrete, steel, and glass. Aluminum was used in patterned castings that form a primary part of the design throughout. The three great structural girders which outline the main tetrahedonal form are encased in concrete poured inside aluminum patterned casings. In this way, the aluminum acted not only as the form but also as the decorative facing. Throughout the building the structural members are covered with similar patterned aluminum shapes to form a rich geometric decoration. Aluminum was used throughout in most of the sculpture and furnishings, including the sculptural "wings" over the ark, the patterned "menorahs", and in the richly illuminated choir screen. Structural aluminum sections and cast aluminum ornament were used in the great triangular fixtures that light the upper synagogue. In these and many other ways, the practical, lightweight, easy forming, and low maintenance properties of aluminum were employed for the enhancement of the architecture. The ancient traditions of religion find a rich and admirably appropriate form with modern building materials in the hands of a master.

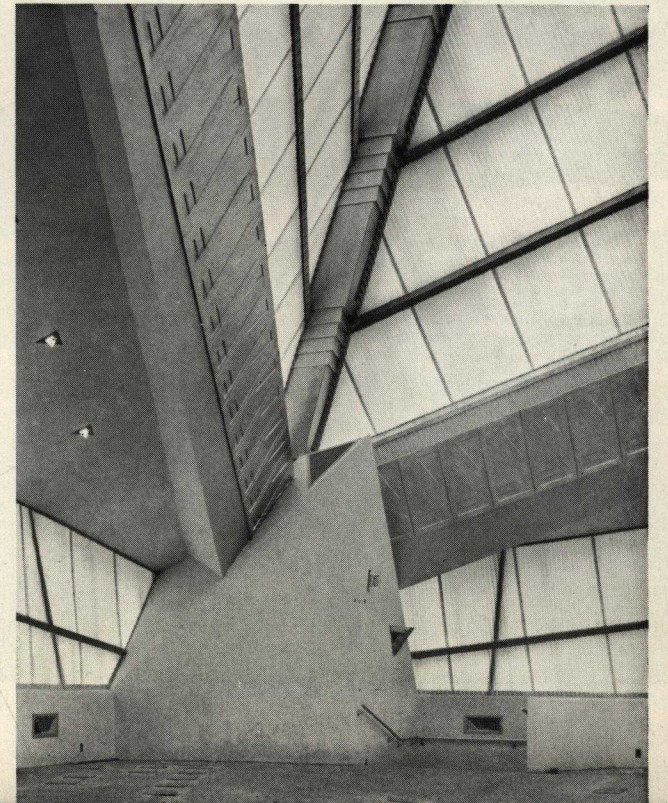
Left In the wealth of detail, it is easy to miss the masterful skill with which Frank Lloyd Wright handled the forms and textures of modern architecture. The dramatic concrete base of the temple here contrasts with the precise aluminum, steel, and glass walls.









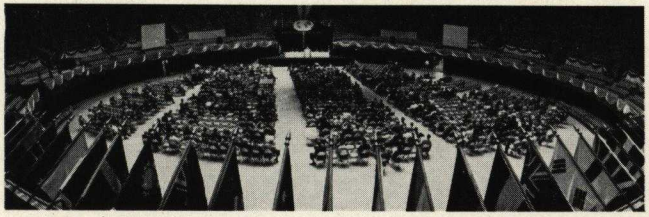


Left From the top of the tripod interior, which rises like a great translucent tent, hangs this aluminum chandelier of brilliantly colored glass trimmed with incandescent lights. **Above** Hexagonal in plan, Wright's temple rises to a striking translucent, triangular tower. **Upper right** These detail drawings show the plan and elevation detail of the cast aluminum sculpture over the ark. **Lower right** Side ramps to the main hall emerge at the great corner buttresses. From the hand-railings to the decorative castings which cover the great beams, aluminum is used throughout the building with imagination and purpose.

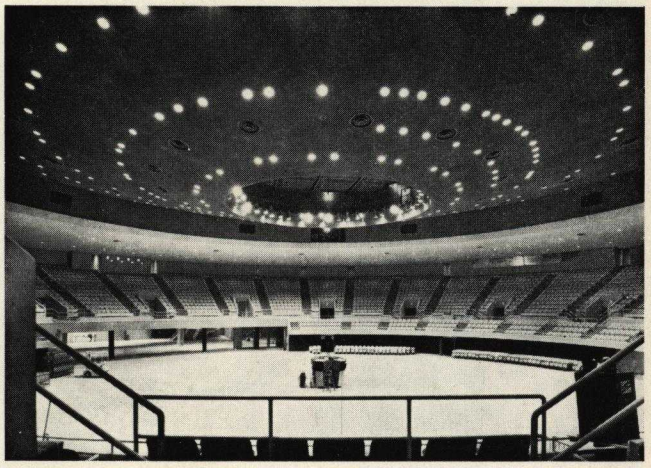
Las Vegas Convention Center

Las Vegas, Nevada
Adrian Wilson & Associates, Architects
Lembke Construction Co., General Contractor

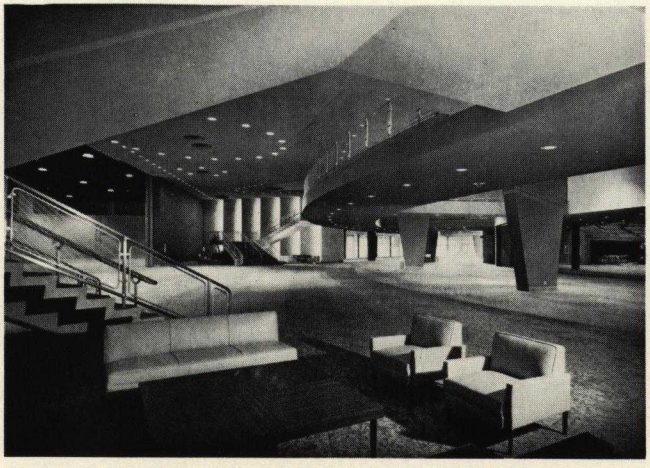
The dominating architectural feature of the huge new Las Vegas Convention center is its mushroom-shaped aluminum roof. This aluminum dome, 316 feet in diameter, is the result of extensive research to achieve a maintenance-free and aesthetically appealing roof. The roof covering affords unencumbered economical space with facilities for conventions, exhibits, fairs, and sports events. More than a thousand sheets of .040-inch anodized corrugated aluminum with a 4-inch rib were used for the roof. Arch trusses connected to a tension and compression ring form the main structure. Purlins were spaced between the trusses to receive the aluminum sheets. These sheets are lapped and sealed with a non-deteriorating sealing compound and anchored to the purlins by bolts. They were then sealed with a rubber base sealing compound of the same color as the aluminum. The ceiling and insulation are suspended from the trusses. Mechanical equipment accessible by catwalks is located between the roof and the suspended ceiling. The architects estimate that this unique design saved half the cost of standard dome roof construction. Throughout the building, both the lightweight and low-maintenance properties of aluminum have been imaginatively employed by the architects to achieve a dramatic building at a considerable and substantial saving.

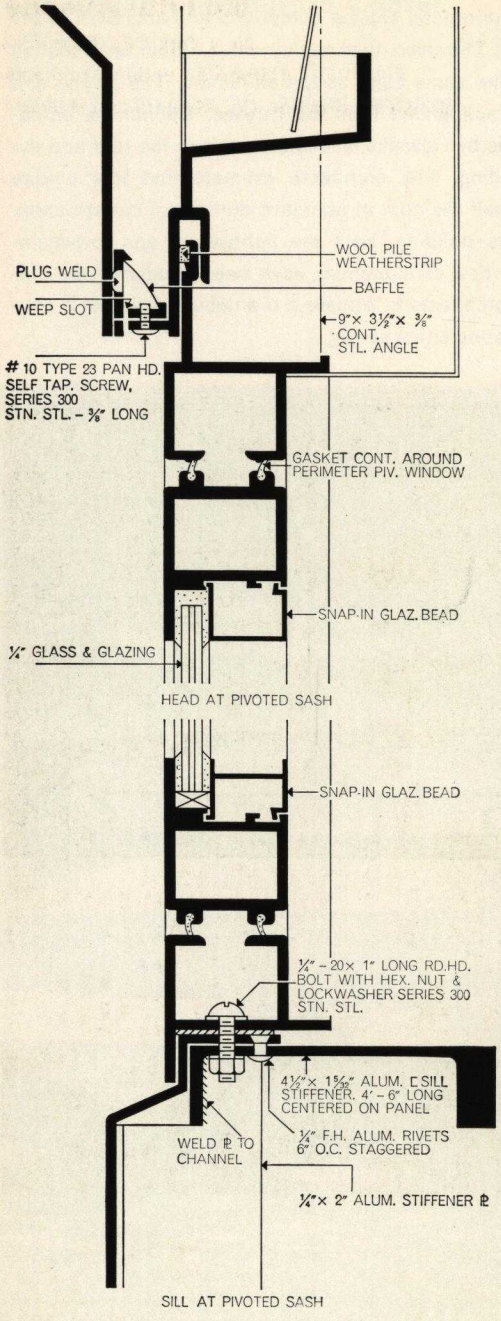


Far left Low-slung arch of dome accentuates the dramatic horizontal lines of the building. **Top and above** An international convention and a trade exhibition show the adaptability of the space. **Below** Easy and pleasant access is provided by the curved hallway with neat aluminum-railed stairs.



Above This interior view shows the suspended ceiling and free space under the dome. **Below** The ceiling fixtures and aluminum-framed windows and doors create a cheerful, light-filled interior in contrast with the dim barn-like interiors of too many convention halls.



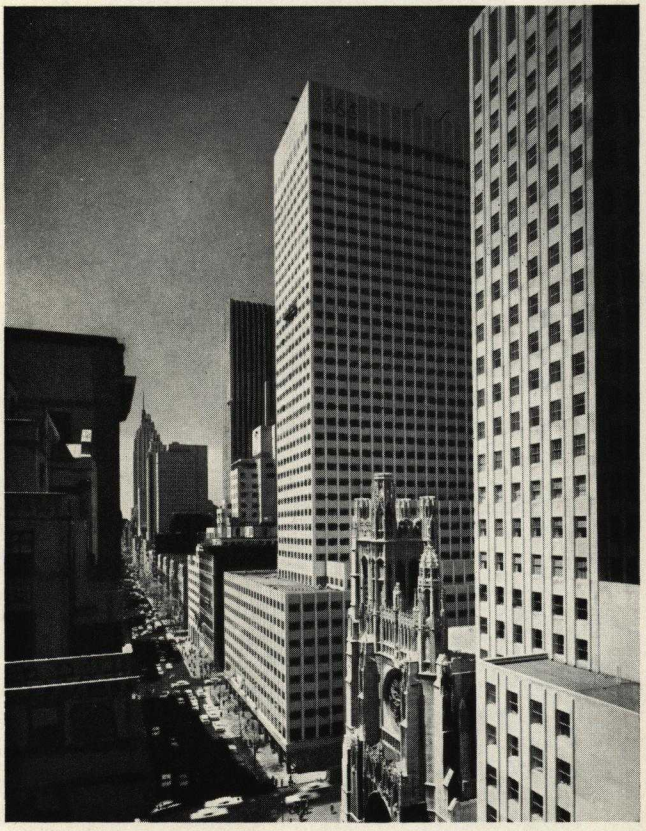

WOOL PILE WEATHERSTRIP
PLUG WELD
BAFFLE
WEEP SLOT
9"× 3½"× ⅜" CONT. STL. ANGLE
10 TYPE 23 PAN HD. SELF TAP. SCREW, SERIES 300 STN. STL. – ⅜" LONG
GASKET CONT. AROUND PERIMETER PIV. WINDOW
SNAP-IN GLAZ. BEAD
¼" GLASS & GLAZING
HEAD AT PIVOTED SASH
SNAP-IN GLAZ. BEAD
½" – 20× 1" LONG RD.HD. BOLT WITH HEX. NUT & LOCKWASHER SERIES 300 STN. STL.
4½"× 1⅝" ALUM. C SILL STIFFENER. 4' – 6" LONG CENTERED ON PANEL
WELD ℄ TO CHANNEL
¼" F.H. ALUM. RIVETS 6" O.C. STAGGERED
¼"× 2" ALUM. STIFFENER ℄
SILL AT PIVOTED SASH

666 Fifth Avenue

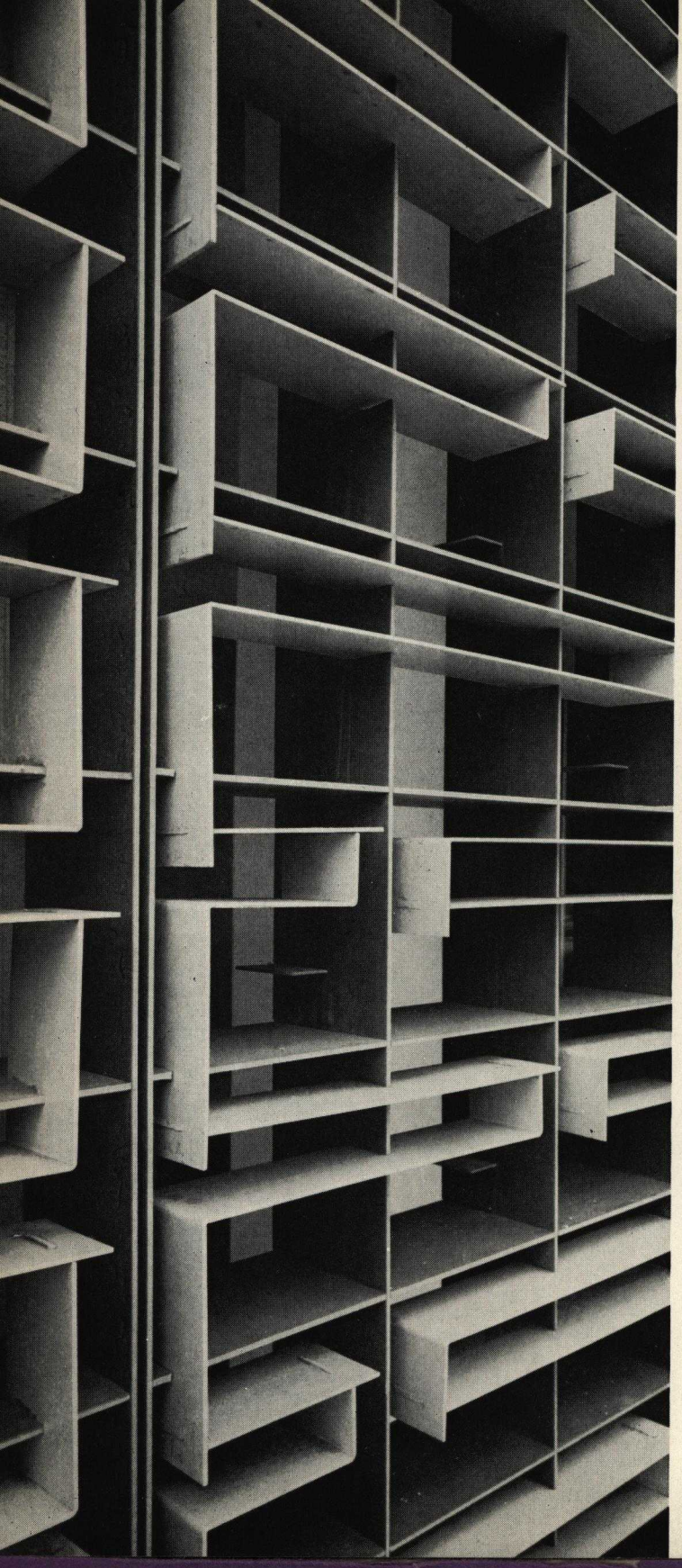
New York City, New York
Carson & Lundin, Architects
Tishman Realty & Construction Co., Owners and Builders

This thirty-nine story office building, with over a million square feet of office space, boasts the world's largest aluminum curtain wall. Over 2900 prefabricated panels of natural finish anodized aluminum form the eye-catching, 8-acre, curtain wall. The upper half of each panel forms a 7-foot window unit. The lower half of each panel is a spandrel with a die-pressed design that gives the building a texture like that of chain mail and the spandrels a rigidity like that of armor. The panels are separated by 20-inch columns of white porcelain-enameled aluminum, extending the full height of the building. The juxtaposition of anodized and porcelain enamel finishes provides an attractive contrast in color and texture without loss of any of aluminum's light weight and low maintenance advantages. The design won from the Fifth Avenue Association the accolade, "Simple in form and rich in its pattern . . . the best new commercial building on Fifth Avenue."

On the street level, several features are designed to catch the eyes of Fifth Avenue strollers. An open arcade is lined with shops and equipped with recorded music. At the back of this arcade, a dramatic 40-foot long waterfall splashes over sculpture designed by Isamu Noguchi. A special pavement of Crab Orchard stone, matching the floor of the arcade, has been installed to the street line. One of the outstanding features of 666 is its dramatic nighttime appearance. Taking advantage of the reflective qualities of aluminum, 72 special mercury-vapor spotlights with a total of over 9.7-million candlepower make the building a brilliant highlight in New York's glowing cityscape.



Far left Detail drawing shows head and sill of the window unit drawn at the central pivoted sash. **Left** The die-pressed pattern on the spandrels was selected after wide testing for both appearance and strength. Panels were set in place from the inside of the building and bolted to vertical steel rails welded to the building frame. Each unit interlocks at the bottom with the one below it. The steel weldments are zinc-sprayed to prevent corrosion. **Above** Looking up New York's Fifth Avenue, the building can be seen in relation to its neighbors. Beyond the benefits of economy in erection and maintenance, 666 has used its vast aluminum curtain wall to achieve special distinctiveness with panel pattern and a special drama with ingenious night lighting.

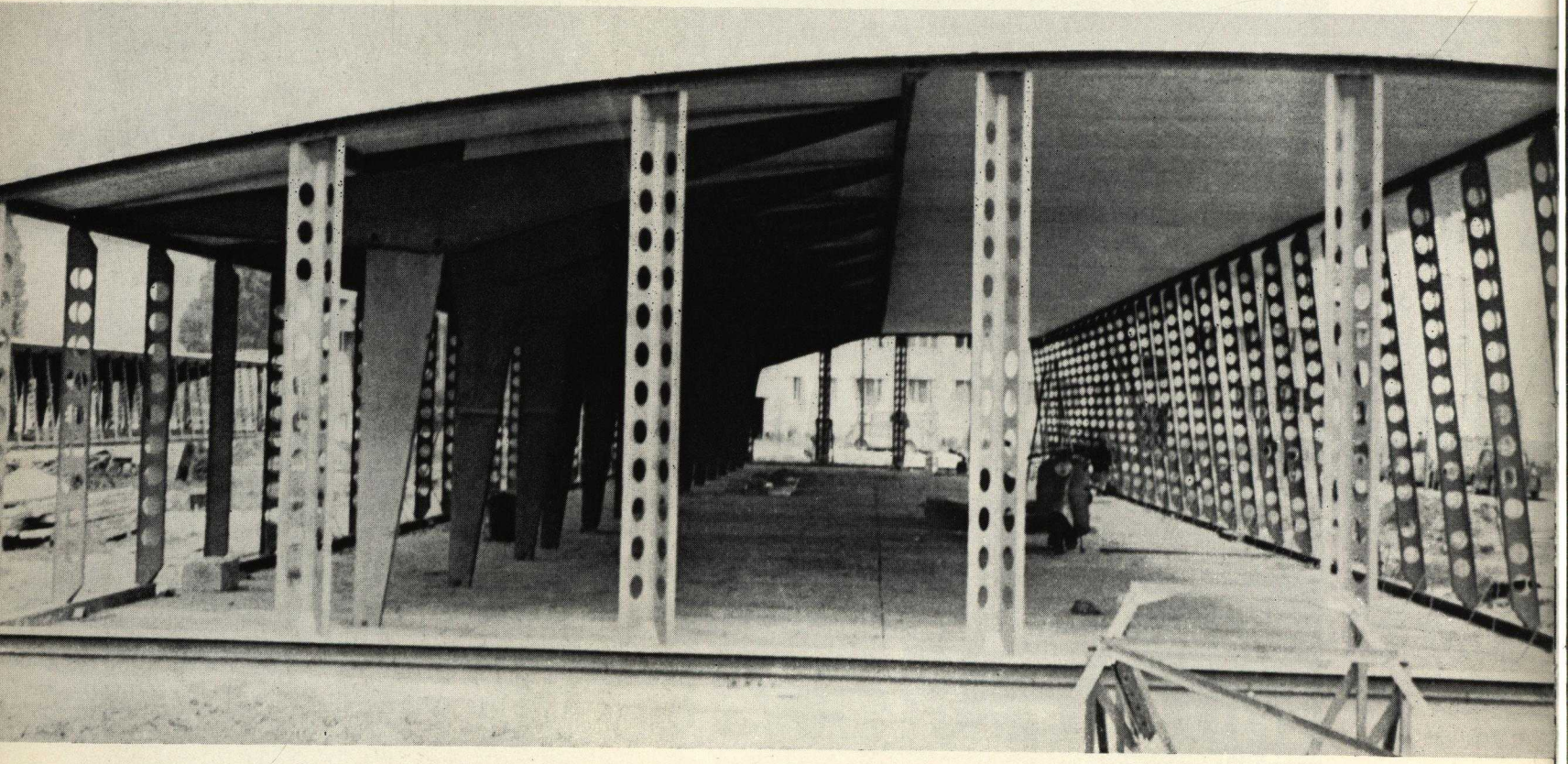


Left This close-up of the sunscreen shows how the aluminum strips were notched together, then welded to form an intricate and varied design. **Above** Two outdoor patios are a unique feature of the Main Library. One can be seen in the top of this photograph. From the mezzanine in the lower part of the photograph is a view of the spacious main floor. Partitioned by movable stacks and furniture, it can easily be rearranged to meet changing needs. **Right** With its lacy aluminum sunscreen, interior patios, and covered arcade, the New Orleans Main Library complements traditional French Quarter architecture and at the same time is a proud example of contemporary ingenuity and design.

Main Library

New Orleans, Louisiana
Curtis & Davis, Goldstein, Parham & Labouisse and
Favrot, Reed, Mathes & Bergman, Associated Architects
R. P. Farnsworth & Co., Inc., General Contractor

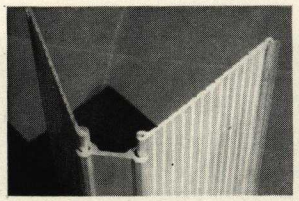
Designed to display the pleasures of books much as a department store displays the attractions of its wares, this library is an outstanding contribution to New Orleans' new civic and cultural center. It illustrates several original and successful architectural solutions in aluminum. Chief among these is the grille which screens the three glass walls. It is formed of slate gray aluminum strips with a dull finish to lessen glare in a playful eggcrate design that reflects light and heat away from the building. These are combined with horizontal strips of contrasting natural aluminum to prevent reflections from bouncing inside. Different alloys were used for the two components so that the finished panels could be anodized in a single operation. Designing this effective screen, the architects developed a rotating and tilting testing table for the model, and calculated the daylong, year around effect of the sun with projected light. The result is a saving which amounts to more than its cost in air conditioning, curtains, and blinds. The screen is hung on aluminum trusses 3 feet in front of the glass. In this space, the architects concealed aluminum catwalks for window washers. The window wall itself has aluminum framing members which provide both drainage and ventilation. A cost-saving aluminum modular ceiling system, using an exposed grid of parallel aluminum bulb tees and perforated aluminum sheets, was designed to give flexibility to the interior. The New Orleans Main Library is a noteworthy example of architectural imagination, overcoming both the budget restrictions and the routine dullness of many civic projects.

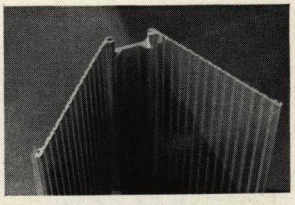


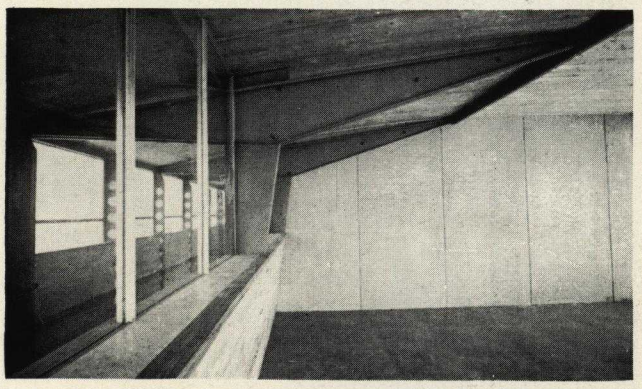
Villejuif School

Villejuif, France
Jean Prouvé, Architect

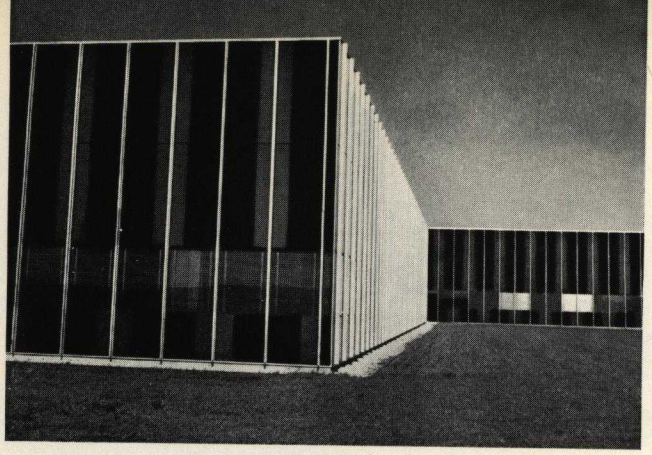
This aluminum school is renowned architect-engineer Jean Prouvé's answer to France's serious need for classrooms and her painfully low budget for building them. Prouvé designed a series of factory-produced parts which could be assembled inexpensively on the site. The buildings can be as quickly dismantled for use elsewhere. This kind of temporary structure with a permanent look was accomplished with a totally new approach to building design and building materials. The roof of glued ply panels spans the width of the building. It is held down by aluminum braces which act as tension members, giving the roof a natural curve. The roof panels are supported on the interior by longitudinal beams and crutch supports. They are protected on the exterior by aluminum sheeting, single-spanned to avoid joints perpendicular to the slope of the roof. The glass wall provides light and view, but Prouvé has delegated the function of ventilation to the circular openings in the aluminum braces. The windows do not open. Their unbroken surfaces are fixed directly to the braces. While the V-shape of the braces was determined by factors of structural resistance and the technical qualities involved in bending sheet metal, the utilization of the shape for ventilation was pure Prouvé inventiveness. The Villejuif School is a noteworthy addition to the series of imaginative buildings in which this French architect has created an original expression of industrialized architecture based on the structural integrity of the modern light metal – aluminum.

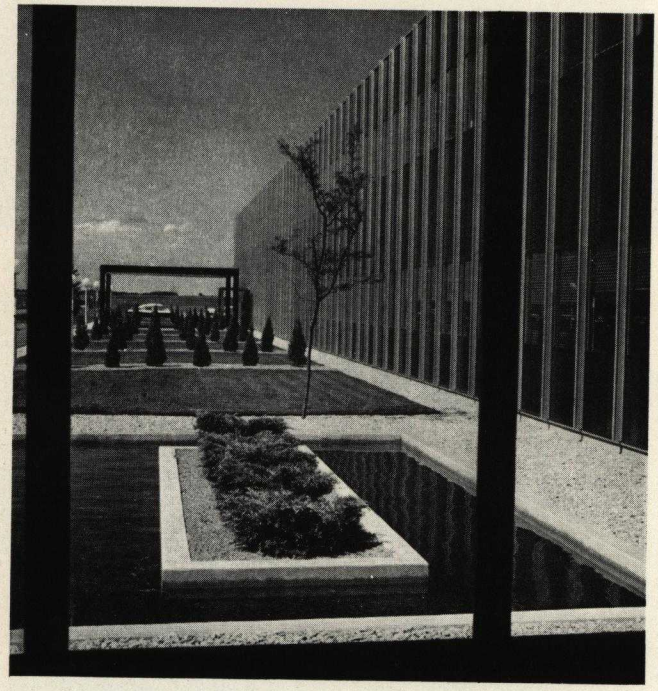


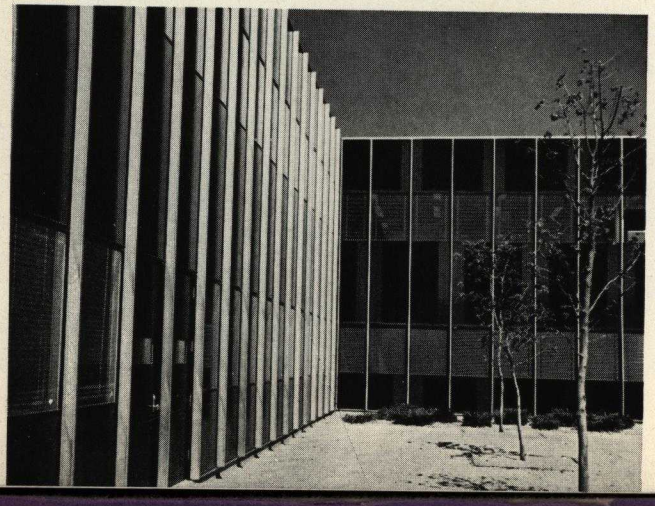




Left top Prouvé's neatly grouped school buildings serve the new housing development in the background. Shown here soon after construction, they will, with sympathetic landscaping, make an aesthetic as well as practical contribution to the neighborhood. **Left bottom** Providing the tension for the roof's curve, the aluminum braces with their series of ventilating openings give the building its most distinctive visual characteristics. **Right top** This view shows two end sections of the movable louvers that control the ventilation. **Right center** Construction photo shows a typical classroom. **Right bottom** The relation of corridor to classroom is clearly revealed at this stage of erection.







Eero Saarinen, a recognized pioneer in curtain wall development, has designed an unusually beautiful and efficient aluminum curtain wall system for IBM's newest facilities in Rochester, Minnesota. The architecture, as well as IBM and Rochester, benefits from a well thought-out city development policy which has zoned only this parcel of land on the outskirts of Rochester for industrial purposes and not the surrounding farm land.

The nine two-story building blocks contain factory, executive offices, laboratories and classrooms. All are enclosed alike behind dignified facades of rib-like aluminum mullions and well-proportioned aluminum spandrels. The laminated spandrels are only $5/16$ of an inch thick, really too thin to be described as "sandwich" panels. The faces of the spandrels are porcelain-enameled aluminum, providing a permanent matte finish to their blue coloring. The insulating filler is a special dense cement-asbestos board with a U factor of 0.241. The panels and fixed windows are joined to the mullions and horizontal members by continuous-mold neoprene gaskets which lock them in place with "zipper" splines. This fastening system is so well integrated that no through-metal fasteners or weatherproofing sealants are needed. Aluminum was chosen for the mullions to attain the extremely close tolerances and the freedom from bow and camber required by their structural function. Because it was designed using a minimum of components, the buildings were erected quickly and easily – a bonus quality in a beautiful building group which serves well IBM's successful program to build company buildings that are outstanding corporate advertisements.

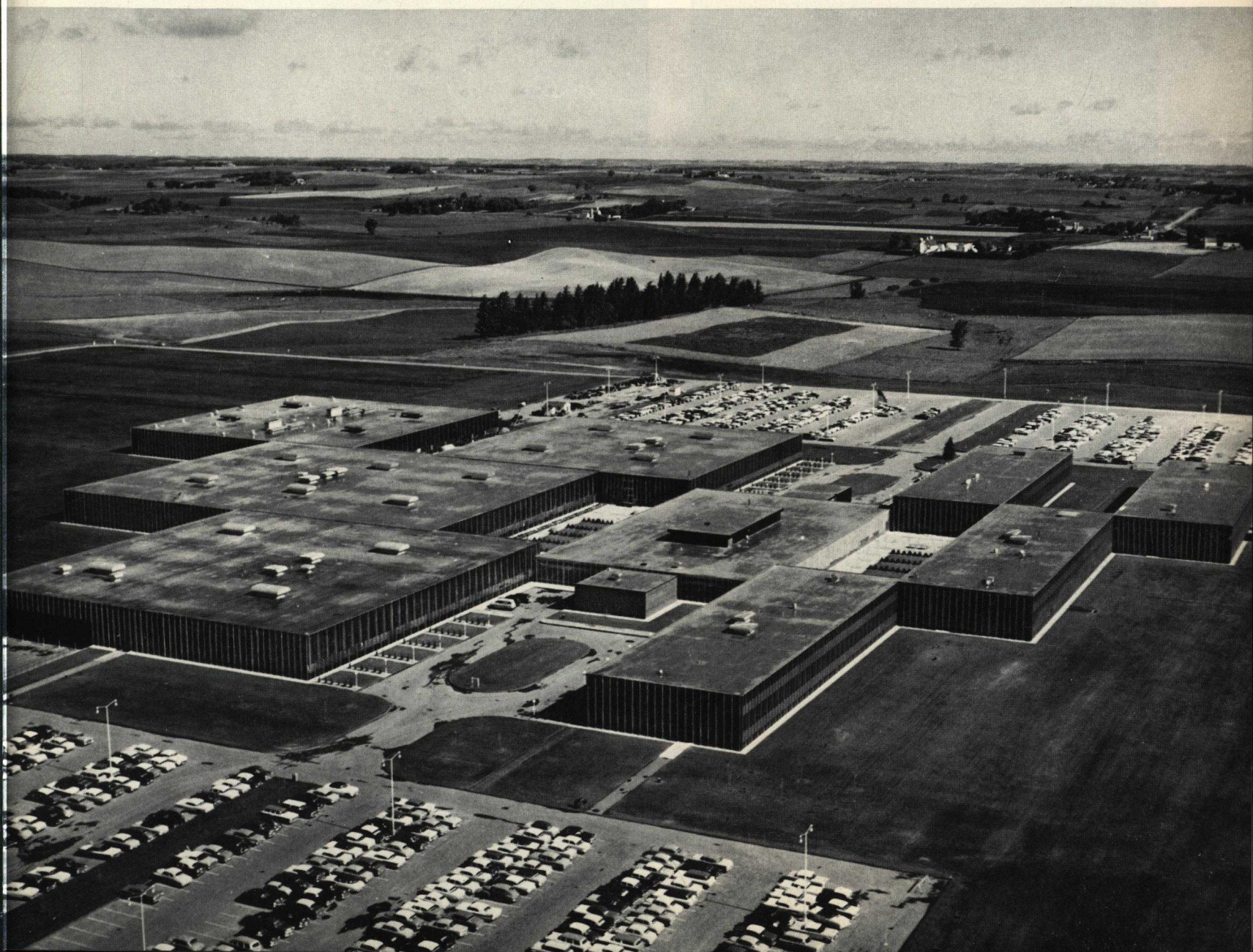
Left top The two hues of blue on the spandrel panels create a sense of shady depth and a pattern of rectangles which avoids the flat, monotonous effect sometimes observed in curtain walls. **Center** Meticulous design is again evident in the details of landscaping and the proportions of the entrance. **Bottom** A striking, classical effect is given by the mullions, made of natural aluminum finished with a five-minute etch. More than 1700 extruded sections ranging from 23 feet, 10 inches to 26 feet in length were used. **Right** An air view of the plant shows the rectangular layout with the nine two-story building blocks in three sizes placed adjacently and punctuated by courtyards.

Manufacturing-Educational Facility International Business Machines Corporation

Rochester, Minnesota

Eero Saarinen and Associates, Architect

Johnson, Drake & Piper, Inc., General Contractor



Kaiser-Friedrich Memorial Church

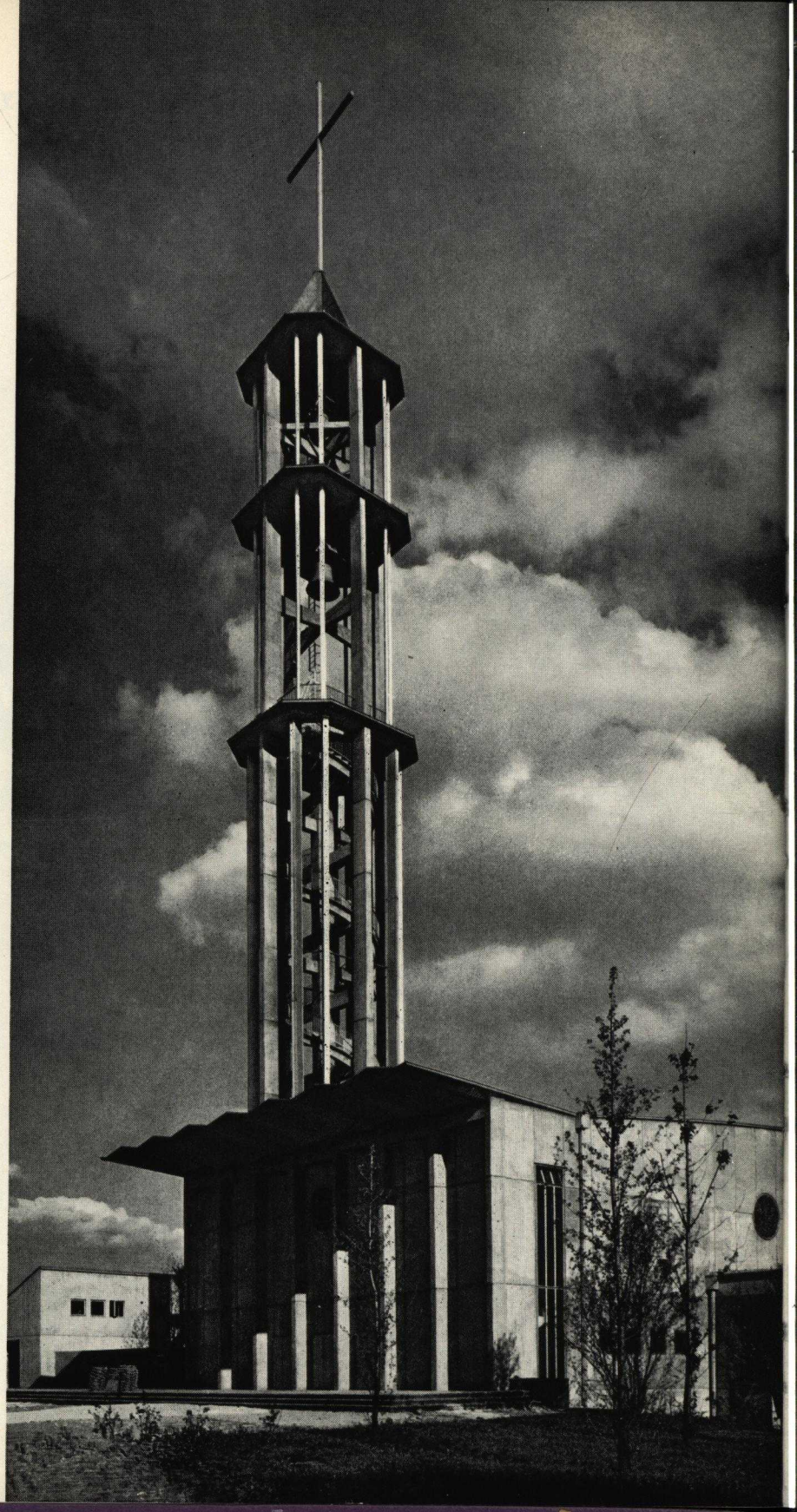
West Berlin, Germany

Professor Dipl.-ing. Ludwig Lemmer, Architect

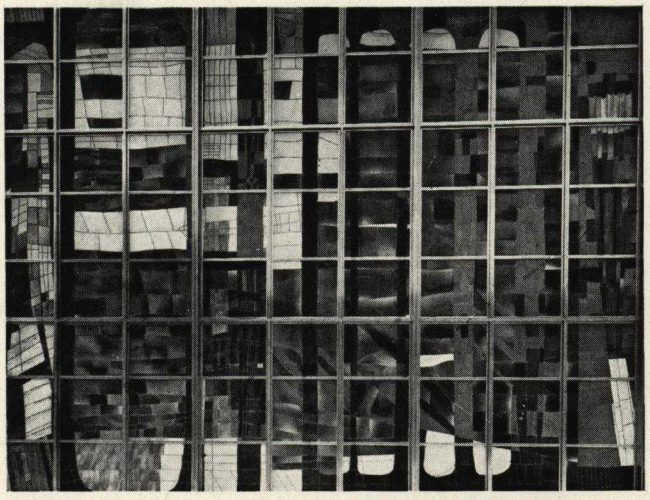
So extensive is the use of aluminum in this German Evangelical Church that the people of West Berlin often refer to it as "St. Aluminum". Contributions from West German industry, government and towns, from ecclesiastical groups of Great Britain, Scandinavia and Switzerland, as well as from groups of the Allied Armed Forces in Berlin financed the building of this new Kaiser-Friedrich Memorial Church to replace the old one destroyed in World War II. For economic reasons the new church was built largely on undamaged foundations of the old, but no effort was made to reproduce its appearance. In addition, a side chapel was added and an adjacent parsonage with an aluminum roof was constructed to provide a community office and youth home as well as a place for the parson to live. The tower has eight aluminum buttresses and a 33-foot aluminum cross. The curving stairs to the belfry, protected by an aluminum railing, afford a pleasant view of a nearby park.

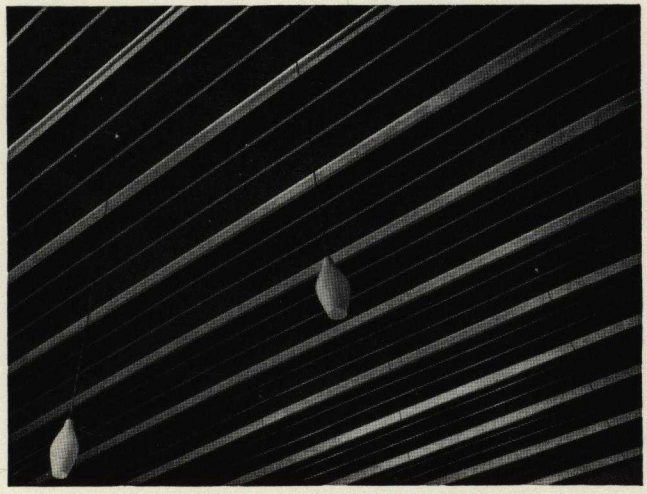
Aluminum is also used extensively inside the church. The use of aluminum for the inner partition walls and in the acoustical ceilings are two of the increasingly widespread European applications of the material. The wide use of aluminum for the organ case, the pulpit, the lectern and the choir stalls, areas which traditionally receive special embellishments, sets a precedent for dignified and elegant applications of a modern material.

The skeleton of the large east window wall, designed by Georg Meistermann, is of shaped aluminum. Gerhard Marcks designed the handsome aluminum portals and Bernhard Heiliger, the 23-foot tall abstract aluminum sculpture that graces the front grounds of the church. The number and reputation of artists who designed the decorations for this church are in the old and great traditions of liturgical art, but executing them in aluminum is a contemporary development.



Right View of the church from the north. For political reasons the tower was made high enough so that the 33-foot aluminum cross can be seen as far as possible within the nearby East Berlin sector.





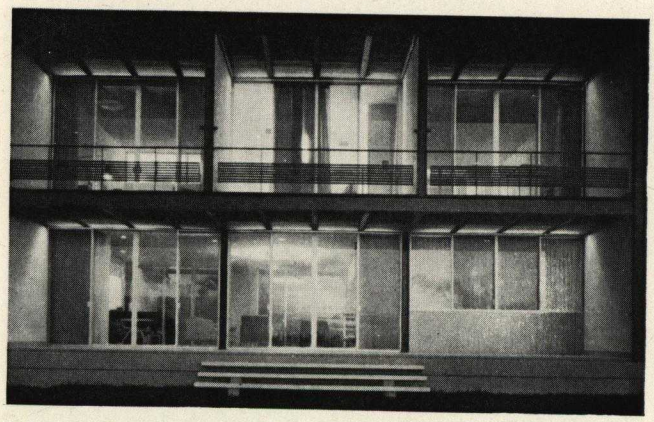
Above The east window wall is an aluminum frame hung at the lintel so that any elongation will be absorbed without creating tensions. Allowance also had to be made for the considerable static compressive stress caused by the wind. **Below** This photograph shows the interior of the Kaiser-Friedrich Memorial Church with rich but simple design. Note the unusual aluminum organ case.

Above Detail of St. George and the Dragon enhances one of the cast aluminum doors which lead into the church. **Below** This close-up shows the acoustical ceiling, while other uses of aluminum include: gutters, downspouts, window frames, doors, fittings, rails, fences, announcement boxes, psalm boards, the soundboard of the pulpit, the parapet of the gallery and glass wall frames.

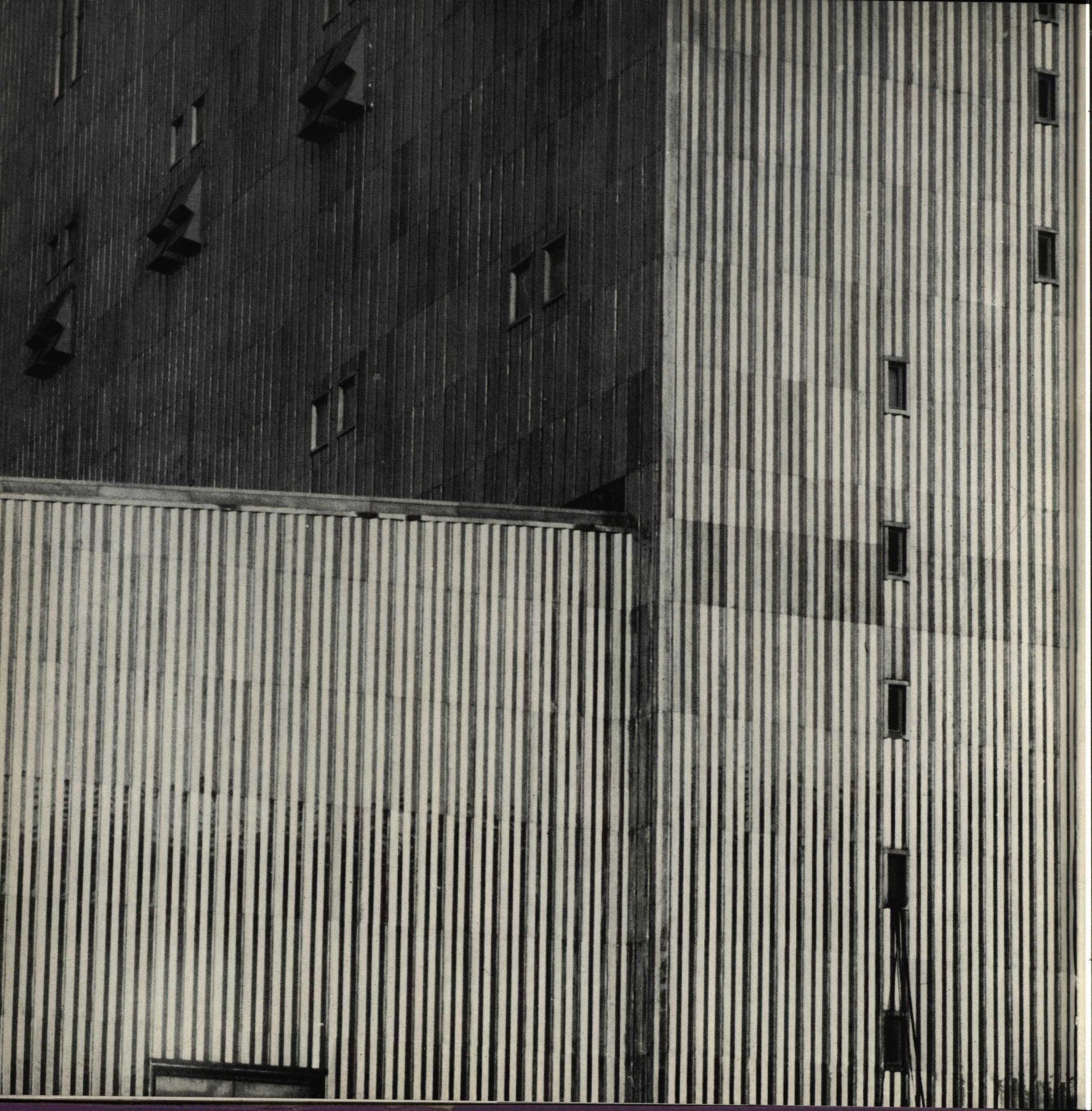
House for Mr. and Mrs. Philip Hiss

Sarasota, Florida
Philip Hiss, Architect
Philip Hiss Associates, Inc. and A. J. Twitchell, Contractors

Any architect's own house is of special interest because it reveals the way he, not a client, wants to live. Philip Hiss's Florida house also reveals a combination of elegance and practicality infrequently found in residential architecture. The materials were selected for durability, ease of maintenance, and especially appearance. After careful study, blue anodized aluminum panels were chosen for the long exterior walls to give the house both color and a feeling of luminosity. A major achievement in the Hiss house is the privacy available to all seven members of the family. This is insured not so much by the ample square footage but by the careful arrangement of rooms. Aluminum-framed doors open out to living areas adjacent to the house, the swimming pool and cabana; and the garage which can be opened or closed for play or parties. In addition, balconies, courts, terraces give the house many delightful, separate places. This is a result of planning which pays attention to human as well as functional needs.



Right This view of the two-story central court with tall insect screens set in aluminum frames indicates the simplicity and precision characteristic of the entire house. Like the aluminum windows and doors, the screens are the width of the 3½-foot module on which the design of the house is based. **Top** Each room has a deep-set balcony or terrace of its own for protection from both sun and rain. Because the rectangular two-story plan is one room wide, a view of the adjacent waterway can be enjoyed from every room. **Middle** The front of the house is screened by plants from the street. The aluminum roof of the cabana in the foreground is designed to provide perfect shelter from sun or showers but ventilated to admit light and air. **Left** Central court separates the house into four zones for privacy: children's bedrooms from master and guest bedrooms; maid's room, kitchen-utility area and dining room from the study and living room.



Iron Ore Hoisting-Separation Plant

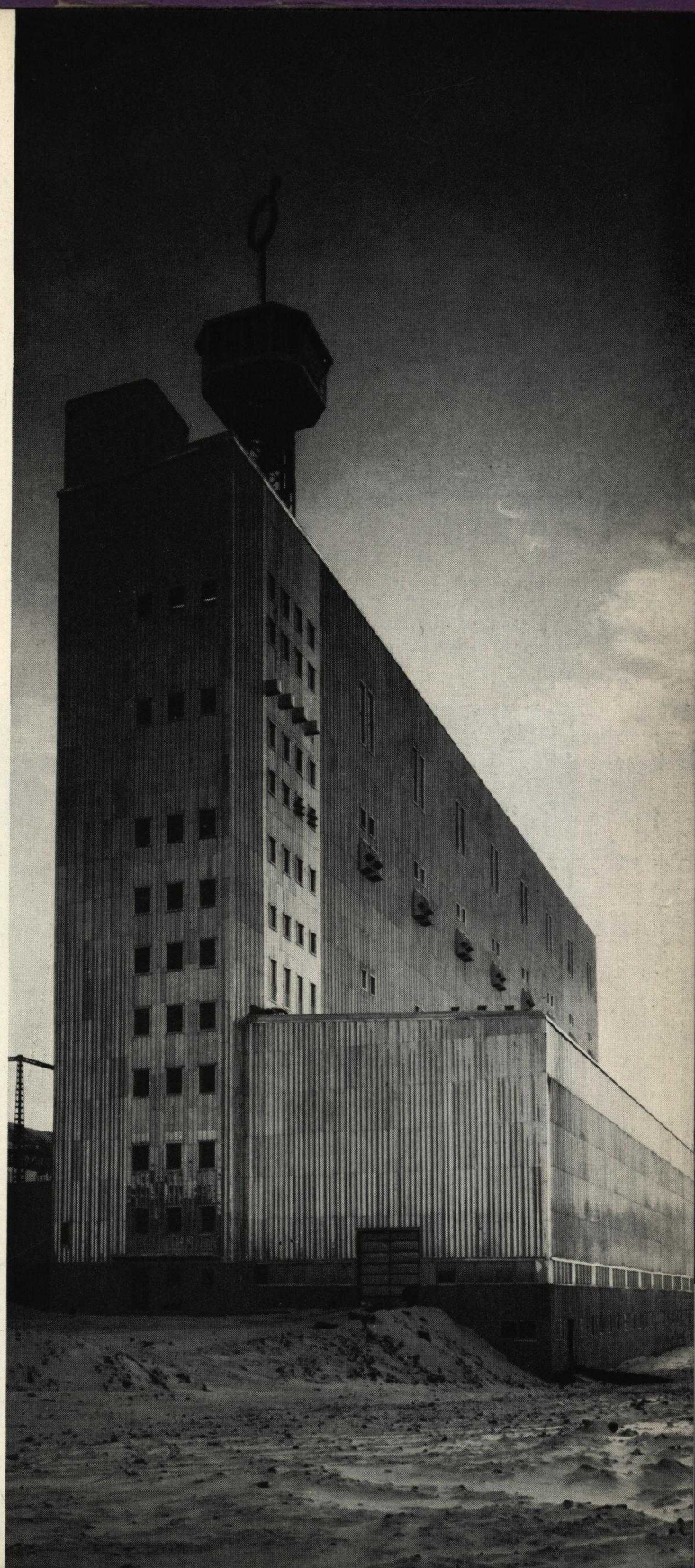
Kiruna, Sweden

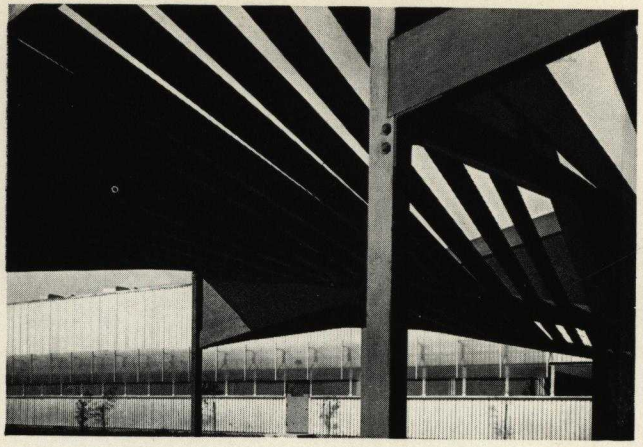
Hakon Ahlberg, Architect

In arctic temperatures, aluminum helps make it possible for men to work comfortably and for heavy industry to operate efficiently. This new plant of Luossavara-Kirunavera (LKAB) in Kiruna, Sweden, is the world's largest facility for hoisting and separating iron ore by the dry magnetic process. Its construction is a major part of an overall program to gradually convert mining from open pit to underground.

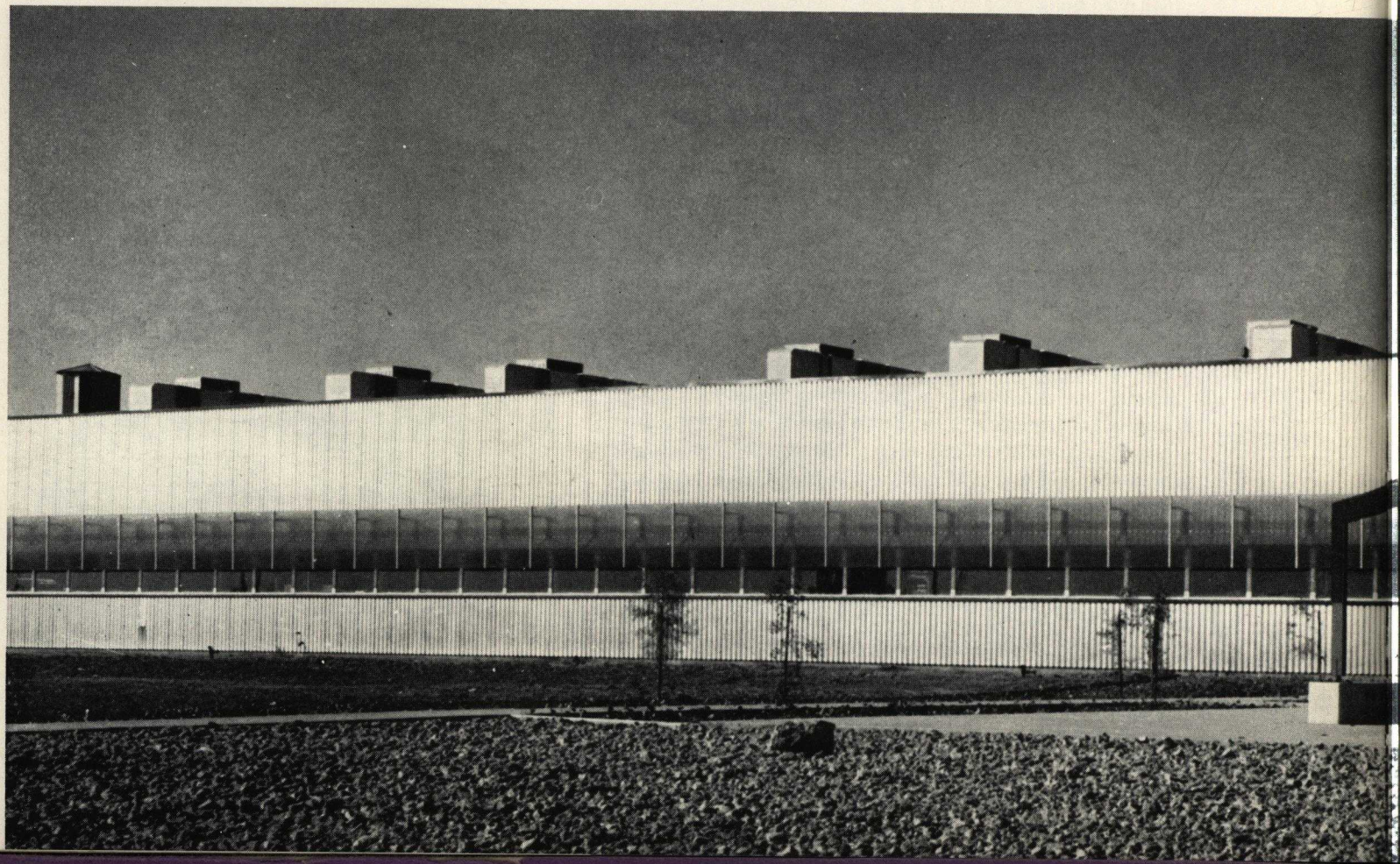
Noted Swedish architect, Hakon Ahlberg, has not only planned carefully for efficient operation – the total plant capacity is 4,600 tons per hour – but has masterfully solved the difficult climatic problems. Since the temperatures in northern Sweden range between 20° and 40° F. below zero in winter, building materials had to be found which would both withstand the extreme cold and provide effective insulation against it. With these requirements in mind, aluminum was chosen to face the entire building. Between the exterior $\frac{1}{24}$-inch thick sheets of corrugated aluminum and the central concrete core of the building is a 4-inch layer of plastic-treated glass wool. This system has proved so successful that the building is heated throughout solely by the surplus heat generated by electric motors that power the machinery. For dramatic exterior effect it would be difficult to top the glistening aluminum facade which reflects the seasons, becoming silver with the snow in winter and golden under the midnight sun in summer.

Left The corrugated aluminum sheeting that covers the entire plant is punctuated only by small windows and looks like the protective armor against weather which it is. Here the weight, maintenance, and reflective properties of this modern building material are employed to cope with the problems of remote regions and inhospitable climates. It is an architectural challenge which promises to occur with increasing frequency as man seeks to use the neglected areas of this planet to support its increasing population. **Right** Architect Ahlberg fitted this enormously powerful and complex mining operation into a unified exterior that is monumental in its simplicity and size.





This factory, designed to fit the client's industrial needs, looks as well as it works. **Above** Detail of the shady picnic area for employees. **Right** A carefully tailored entrance greets the public. **Below** The neat sweep of the expandable aluminum side wall is given vertical emphasis with the corrugated panels and variety in the rhythm of windows and sunshades.

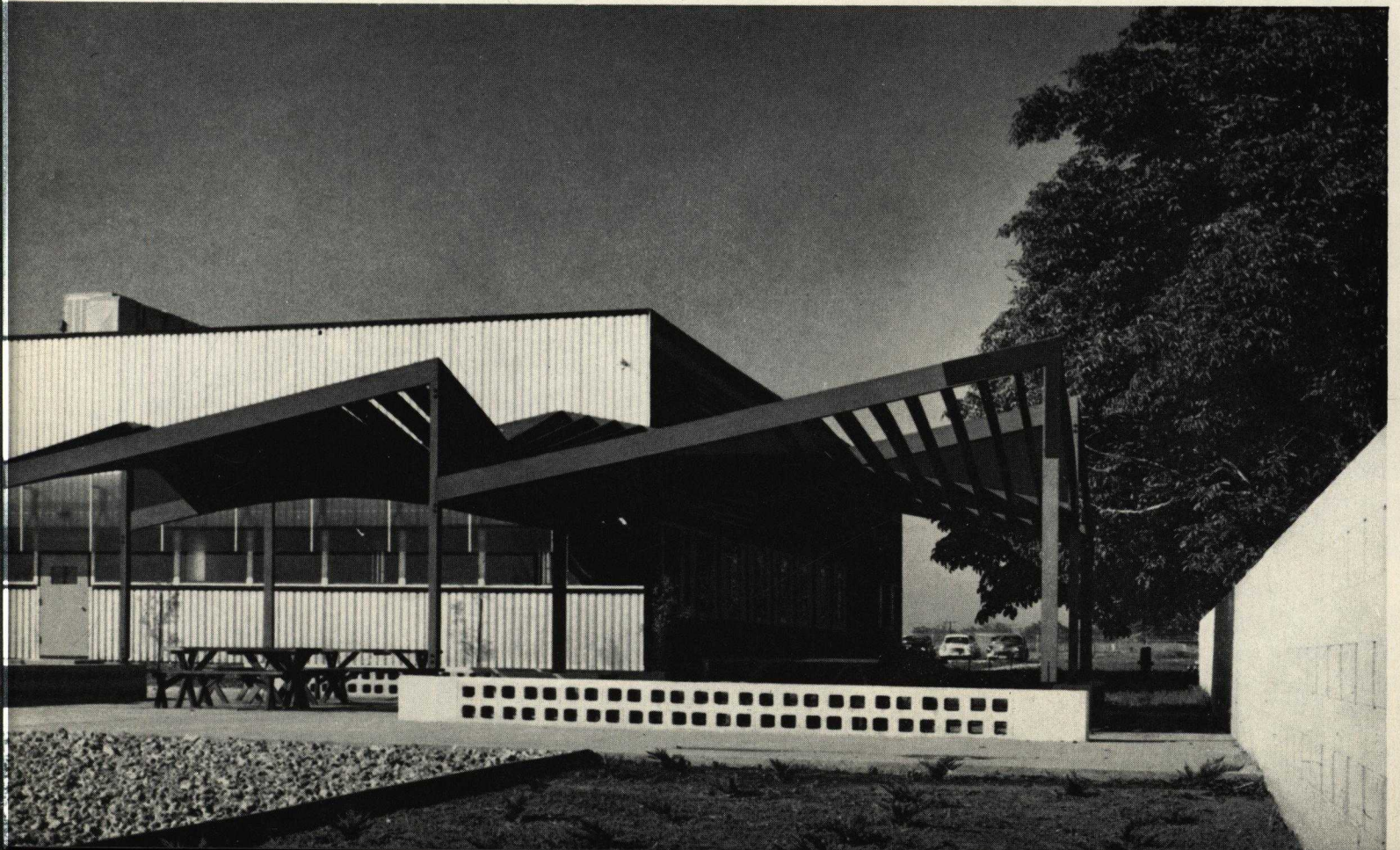


Torrington Manufacturing Co.

Van Nuys, California
Marcel Breuer and Associates, Architect
Wohl-Calhoun Co., General Contractor

A fan factory in California that provides the client with an optimistic opportunity for future growth has been designed by the internationally renowned architect, Marcel Breuer. The rectangular block of 18 square bays faces a convenient highway in front and an important railroad at the rear. The end walls, three bays wide, are of masonry. The side wall of corrugated aluminum and glass can be moved out a bay's width at a time.

Careful planning makes this possible. First of all, a checkerboard roof frame construction makes the structure more rigid and less heavy, so that the side walls may be moved with safety. Secondly, while the fixed end walls are locked to the supporting, exposed columns, the side walls are fastened to the frame by studs which span the columns. The side walls also provide efficient insulation, especially important in a factory using an extraordinary amount of electric power in its operations. Inside, the aluminum panels are finished with rigid insulation above the windows, hard-board below. Outside, free-standing, detachable, sunshades shield the windows, in a plant that considers today's maintenance as well as tomorrow's growth.



Commonwealth Promenade Apartments
900 Esplanade Apartments

Chicago, Illinois
Mies van der Rohe, Architect
Herbert S. Greenwald and Samuel N. Katzin,
Builders and Developers

Mies van der Rohe, one of the most influential architects of our times, is a past master at combining aesthetic elegance with technical invention. The meticulously detailed aluminum wall sections of these two Chicago apartment projects are of record size. Prefabricated aluminum frames are fitted into 9 by 21-foot panels – a story high, a bay wide. Designed to eliminate as many construction joints as possible, they are protection against leaking. They are also much less expensive to fabricate and faster to erect. A comparison of the two projects in the photographs below presents a unique opportunity to note the effect of black anodized aluminum curtain walls in contrast to the natural-finished ones. In both projects, panes of glare-reducing gray-tinted glass are fitted into the aluminum frames. Additional curtain wall trim, such as corner column covers, roof fascias and flashing as well as column covers, mezzanine slab fascias, window wall frames, doors and door frames, intake and exhaust louvers, and frames are all of lightweight aluminum. The result is the restrained use of a relatively few materials in precisely proportioned form characteristic of Mies van der Rohe's "less is more" aesthetics. These apartment skyscrapers in Chicago are stunning prototypes in Mies' lifelong efforts to develop a basic architectural language for our era.

Left Construction photo shows the prefabricated aluminum frames being fitted into place. **Above** The two 29-story buildings of the 900 Esplanade project have aluminum frames anodized black.

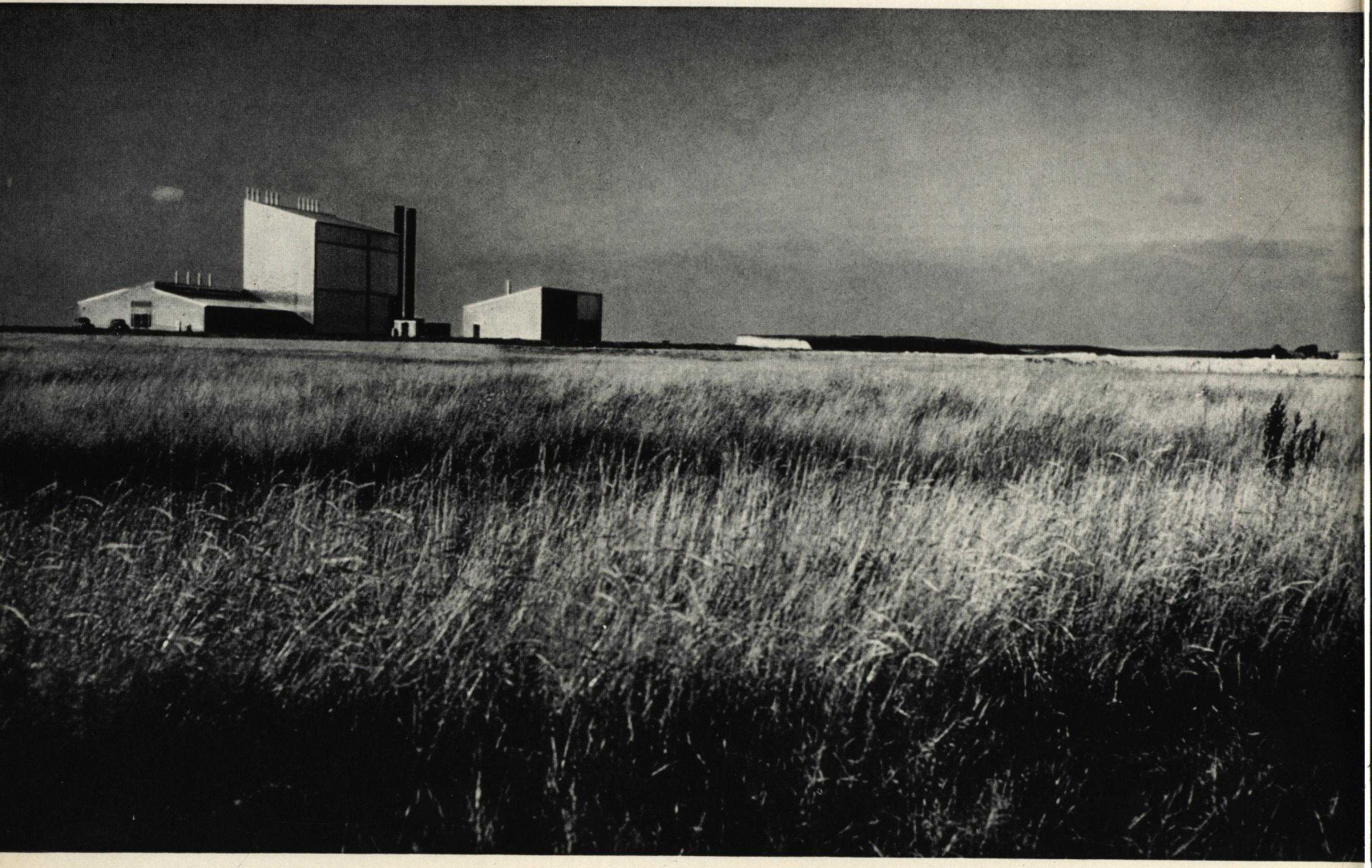
Above The 28-story buildings of the Commonwealth Promenade project use naturally finished aluminum frames. Both projects are identical in construction and general design details.

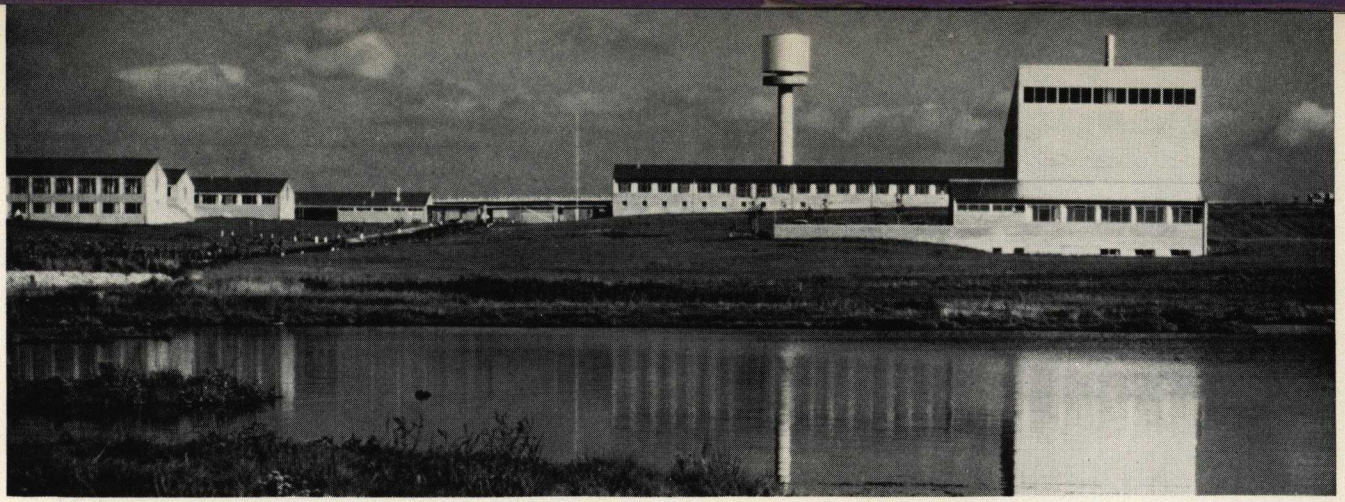
Atomic Energy Research Establishment

Riso, Denmark

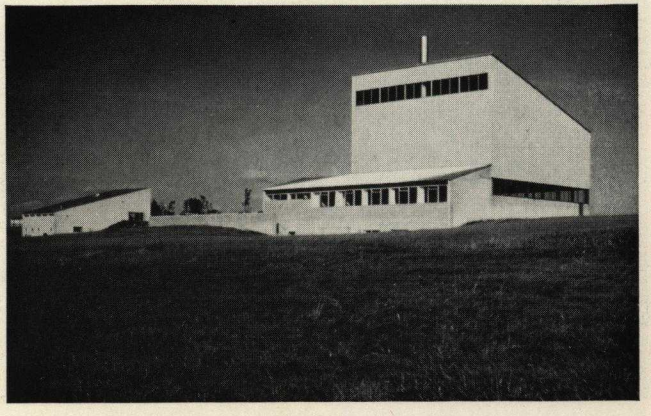
Preben Hansen with Paul Niepoort, Architects

The Danish Atomic Energy Commission has built in Riso a research and educational center, every bit as modern and efficient in design as it is in purpose. It is part of the international program to develop peaceful uses of atomic energy. The facilities include three different nuclear reactors, a decontamination and water treatment plant, laboratories, a special section for agricultural experiments, library, lecture halls, canteen, and maintenance facilities. Time was an important factor in the Commission's program. Standardization and prefabrication were employed to save both design and building time. Aluminum fitted these needs especially well and has been used extensively throughout the project for roof and window coverings, windows, sunscreens, inside acoustic covering, tubes, containers, and tanks, as well as for the all-important reactor tank.





Far left Located on a peninsula, the research establishment is isolated by farmland and water. **Top** Photo shows part of the complex, including laboratories. **Middle left** The high tower is sheathed in corrugated aluminum. **Bottom left** Close-up shows exhaust pipes and aluminum siding. **Above** Interiors are in keeping with the crisp styling of exterior. **Below** The low-energy reactor used for educational purposes is housed in a simply designed, light aluminum structure.



South Bay Bank

Manhattan Beach, California
Craig Ellwood, Architect
Gattmann & Mitchell, General Contractor

Modern bankers have been among the most consistent investors in modern architecture. The aluminum-grilled South Bay Bank of Manhattan Beach, California, is a particularly happy example exhibiting an appreciation of both modern design and modern materials. The modular plan, the meticulously arranged interior and the central entrance flanked by the two aluminum grilles create a strong sense of order. The open architecture with an interior free of structural members, along with the decorative grilles, gives the building an air of lightness both during the day and at night. This quality is heightened by the imaginative control of illumination, both natural and artificial. The columns and fascia are exposed and painted blue to contrast with the anodized aluminum. Girders are inverted and tapered. The rigid frame required for seismic forces was designed on a module and the entire building appears as the precise product of a modern machine. These qualities reflect architect Craig Ellwood's view of the relationship between the machine and architecture, "The craftsman is gone and we have helped to stifle him. Our economy dictates that machine products, machine techniques be the essence of our building. . . . It seems possible for us, however, to produce an architecture that spiritually transcends the prosaic limitations the machine has seemingly begun to impose."

Below Two aluminum grilles on this west entrance are neatly integrated into the striking composition of the simple facade and give a softness to the nighttime appearance of the building.

Right Green courts at the west entrance are formed by the aluminum grilles that shade the structure, both reflecting the heat and cutting the glare of the brilliant California sun.

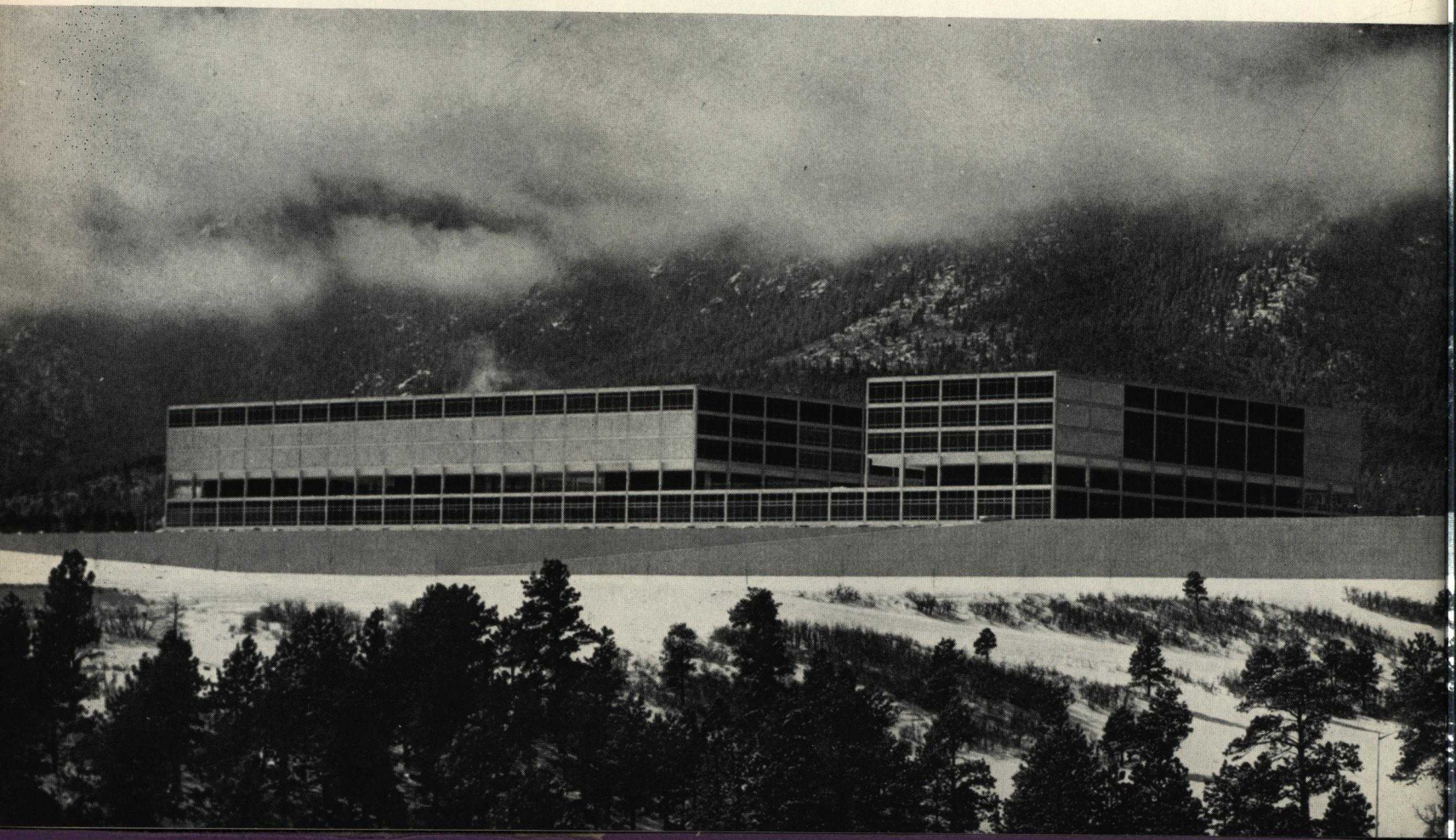
Air Force Academy

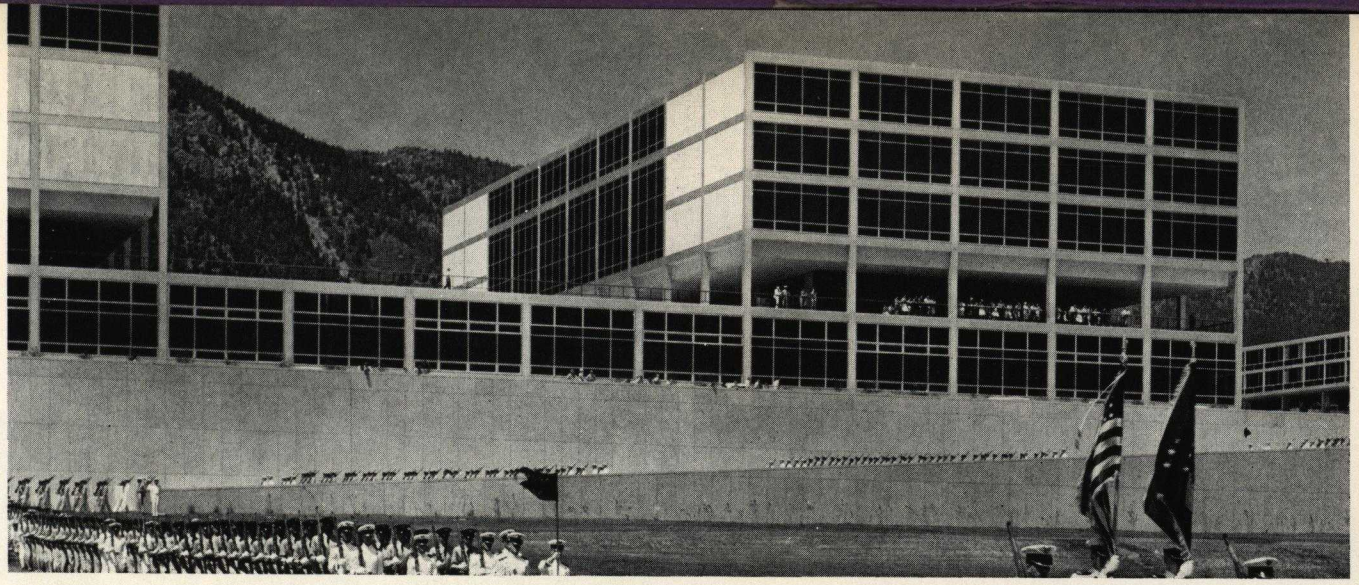
Colorado Springs, Colorado

Skidmore, Owings & Merrill, Architect-Engineers

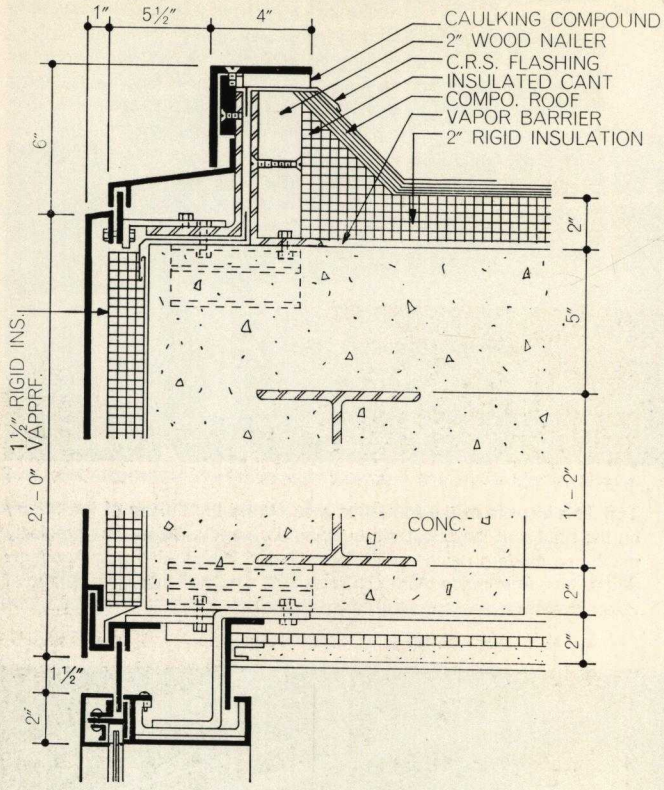
Set among the foothills of the Rocky Mountains near Colorado Springs, the architectural firm of Skidmore, Owings & Merrill has designed the nation's first academy in the modern style. It is particularly appropriate that aluminum, so intimately associated with the development of aircraft, should find an important place in the design of the United States Air Force Academy buildings. The wide use of the material was determined, after extensive structural and weathering tests on the location, by the same practical attributes of light weight and low maintenance that have proven so important in planes. From an aesthetic standpoint, the frameworks of the gleaming buildings set on great granite-bound ramparts have a sense of light and air. Each building, precisely designed of gleaming industrial materials–aluminum, steel, and glass–sets like an airplane, quite independent of the countryside that surrounds it. This impression is heightened by stilts, cantilevers, and open hallways which seem to lift them free of the broad base.

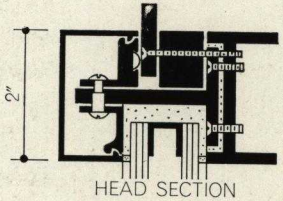
The buildings are marked by an appropriate and elegant use of aluminum from major parts to minor details. For example, the beautifully designed curtain walls of all the buildings on the entire campus are aluminum (see detail drawing on page 50), while such aluminum touches as edging strips around opaque walls of Italian mosaic were selected for their bright look in the sparkling Colorado sunshine. This is nothing less than typical of the sensitive care linked with bold concept which distinguishes this new Air Age Academy.





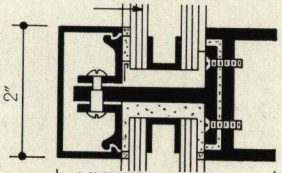
Top This view from the formation area shows the linking of the library on the right and the academic building on the left. **Below** The precisely machined modern design of the new United States Air Force Academy placed on a man-made mesa contrasts with a rugged mountain setting of unusual natural beauty.





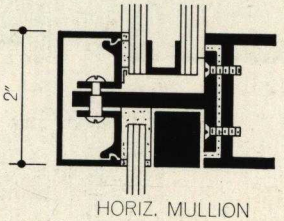
HEAD SECTION

1" INSULATING GL.



MULLION SECTION

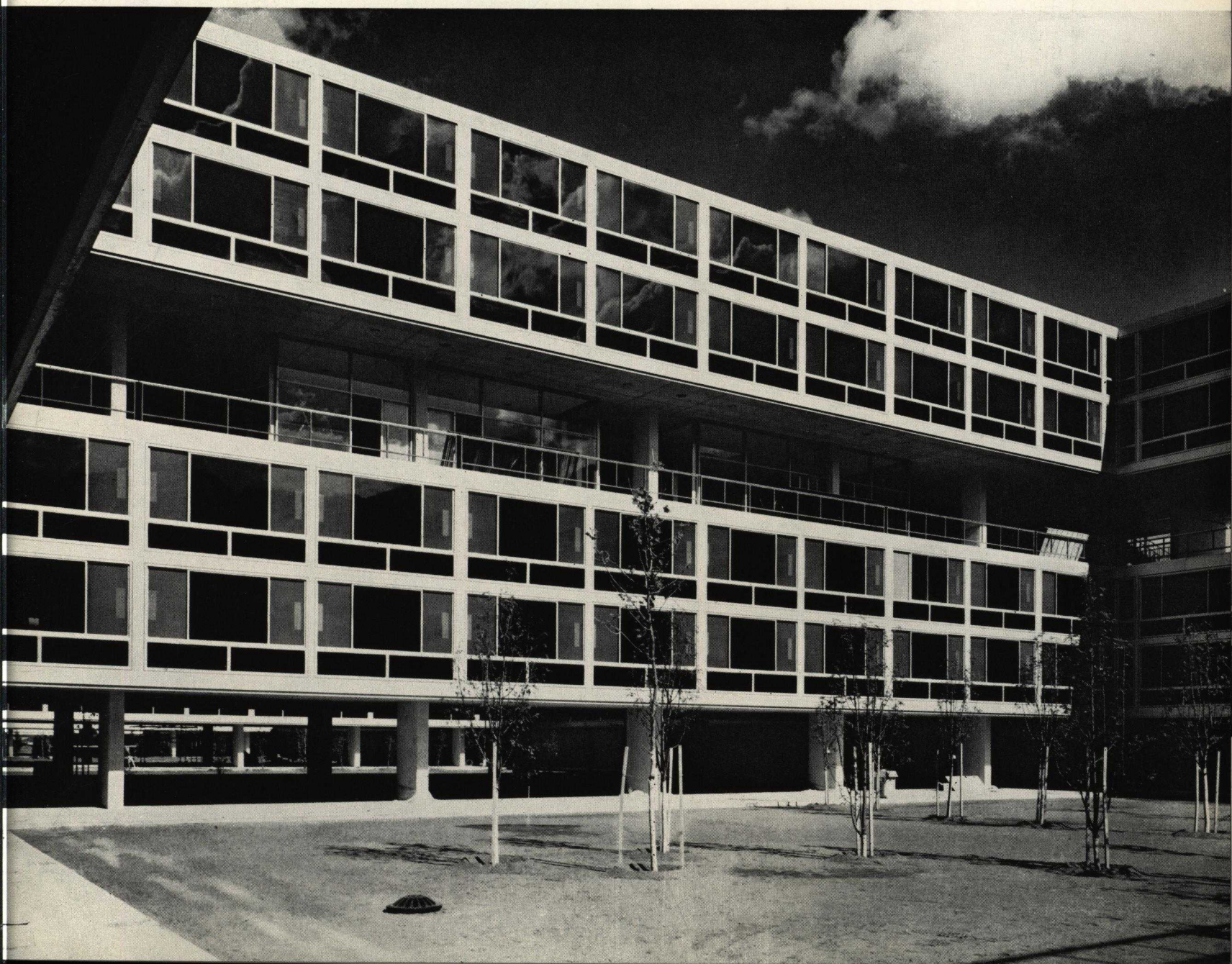
1" 1¼" 4¾"



HORIZ. MULLION

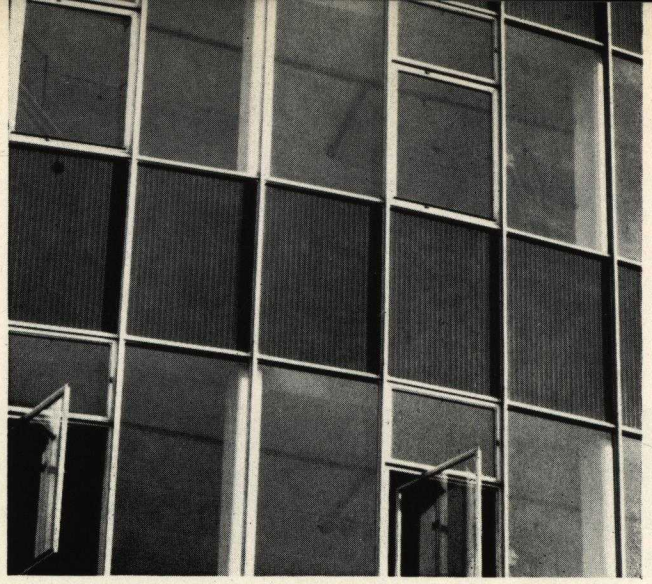
Left These detail drawings show the typical exterior bay of the Academy Administration, Superintendent and Staff Building. **Above top** A dramatically modern spiral staircase dominates the view of the guest entrance to the dining room for senior personnel and guests. **Above** The typical curtain walls of aluminum and glare-reducing glass are shown in this entrance to the dining room.

Below The cadet living quarters, viewed from the outside court, extend for one-quarter of a mile across the northern segment of the academic area conveniently central to other campus buildings. The 1320 two-man rooms have striking views which look out on unspoiled Rocky Mountain scenery. Each living unit features sliding aluminum windows and exterior walls of aluminum and glare-reducing glass. The lower level open floor provides entrance to the gardens and in the foreground shows the planting which on maturity will handsomely landscape the courtyard.



Tower House

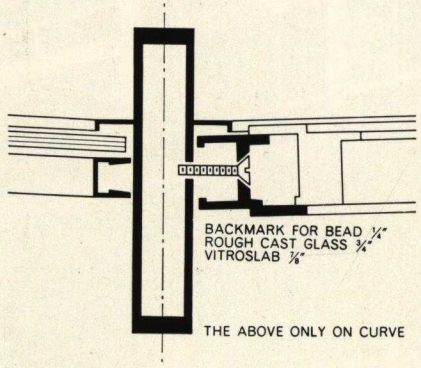
London, England
Justin H. Alleyn, Architect



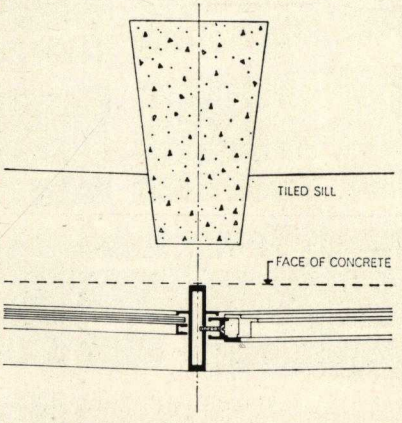
Close-up of aluminum and glass curtain wall showing faceting of curve.

The first curved aluminum curtain wall in England has been recognized as a notable architectural achievement. The curve, really a series of facets plotted from three centers, required meticulous drafting by the architects and cutting by the fabricator. The architects had to save as much weight in the building structure as possible because the river site is subject to tidal flooding. At the same time the structure had to support 672 pounds per square foot of heavy printing machinery on the high floors. The solution was a reinforced concrete frame on a foundation of pressure piles driven 25 feet deep. The floor beams are cantilevered out from main columns set 15 feet inside the perimeter of the building. At the perimeter, nonstructural columns carry the floor slabs and bear some of the load of the machinery. They are slim and placed edgewise so as to block as little natural light as possible.

Lightness of appearance and lightness of weight are the contributions made by the aluminum and glass curtain wall which is fastened to the floor edges. A strong horizontal emphasis is created by the alternating bands of window and bands of glass spandrels which are colored dark red on the front of the building and white at the back. Here a specific translation of the now popular curtain wall idiom has resulted in an interesting and individual architectural statement.



Window and panel detail for the curved portion of curtain wall which required careful specification and exact cutting.



Plan of typical perimeter column. These mark the points of the curve. Slim section was allowed by using thin casing of fire-resistant plaster.

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The unique circular design of this 300-bed unit saves steps for the nurses and money for the Valley Presbyterian Hospital. Although it contains somewhat smaller rooms than the average hospital, many more facilities were possible within the severely limited budget because of the saving in some 2,000 square feet. All the patient rooms are on the perimeter with the work areas at the core. This design places all the facilities conveniently near each patient's room and permits closer observation of each patient's needs by the hospital's staff doctors and nurses. In each room the two beds are placed next to the full windows so that the patient enjoys natural light from behind and a view of the activity in the busy central corridor.

The two aluminum louvers which shade each room's window are individually controlled from the patient's bed. These shutter-like louvers are made of two sheets of aluminum and are constructed like airplane wings for strength. They curve slightly and taper from 3 to 4 inches in thickness at the pivot edge to a knife blade outer edge. In addition to the individual controls from each bed, the louvers can all be closed at once by a master switch to form a solid wall in case of emergency. In planning this small private hospital, the architects have deliberately and successfully avoided the institutional look. The happy choice of the circular shape and the play of light on the aluminum louvers make it a cheerful, as well as an efficient place in which to return to health.

Valley Presbyterian Hospital

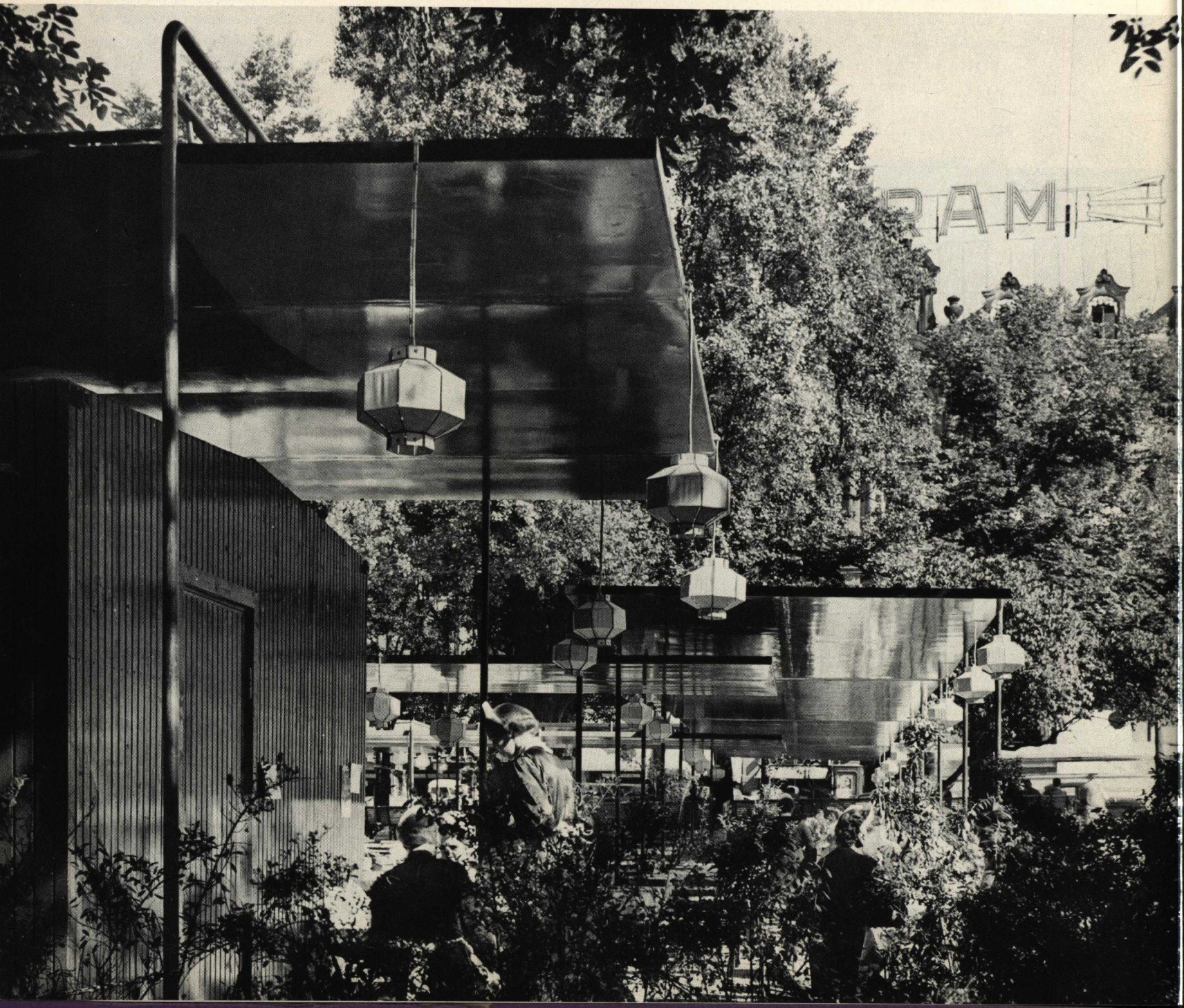
Van Nuys, California
Charles Luckman Associates, Architects with
William Pereira, Associate Architect
Steed Brothers, General Contractor

Above, far left Eastern view of the hospital shows the distinctive shape formed by the curved patient wing related to the horizontal and vertical wings. The design avoids the institutional look which is an important asset to a hospital located in an attractive residential section. **Below, far left** Interior furnishings were also selected for non-institutional appearance. **Above left** In the circular patient's wing, every room is the favored corner room, since all the rooms receive the sun for a portion of each day. **Below left** Close-up photograph shows the 12-foot high aluminum louvers which shield the floor-to-ceiling windows from the sun. **Above** The individually controlled louvers create an ever-changing facade of light and shadow that dramatizes the unusual circular plan of what has been aptly described as "a hospital in the round."

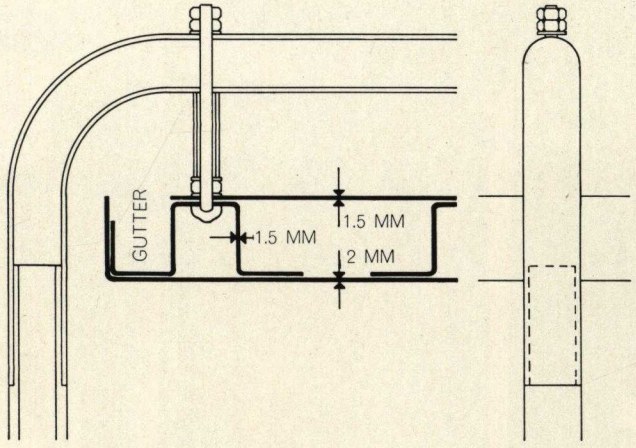
Sarah's Tent

Oslo, Norway

Eyvind Moestue, Architect



Left Variations in ceiling height, cheerful hanging lights, and reflected sunlight create the pleasant effect of an airy, outdoor pavilion. **Below** This detailed drawing shows the aluminum roof construction and how it is fastened to the supporting demountable aluminum tubes.



Above This open-air restaurant is as inviting as the shaded trees and as sparkling as the pool and fountain that are near it. **Below** From a short distance the structure blends modestly into the park vista, as required by Oslo's municipal authorities.

Opposite Parliament in Oslo is a celebrated summer restaurant called Sarah's Tent, where residents and visitors have found relaxation for many years. Because it blocked the view of a new pond and fountain added to the park, city officials ruled that the restaurant could remain only if a new structure was built of a light construction easy to erect in the Spring and dismantle in the Fall. Furthermore, they wanted an open structure that would not interrupt the park scene.

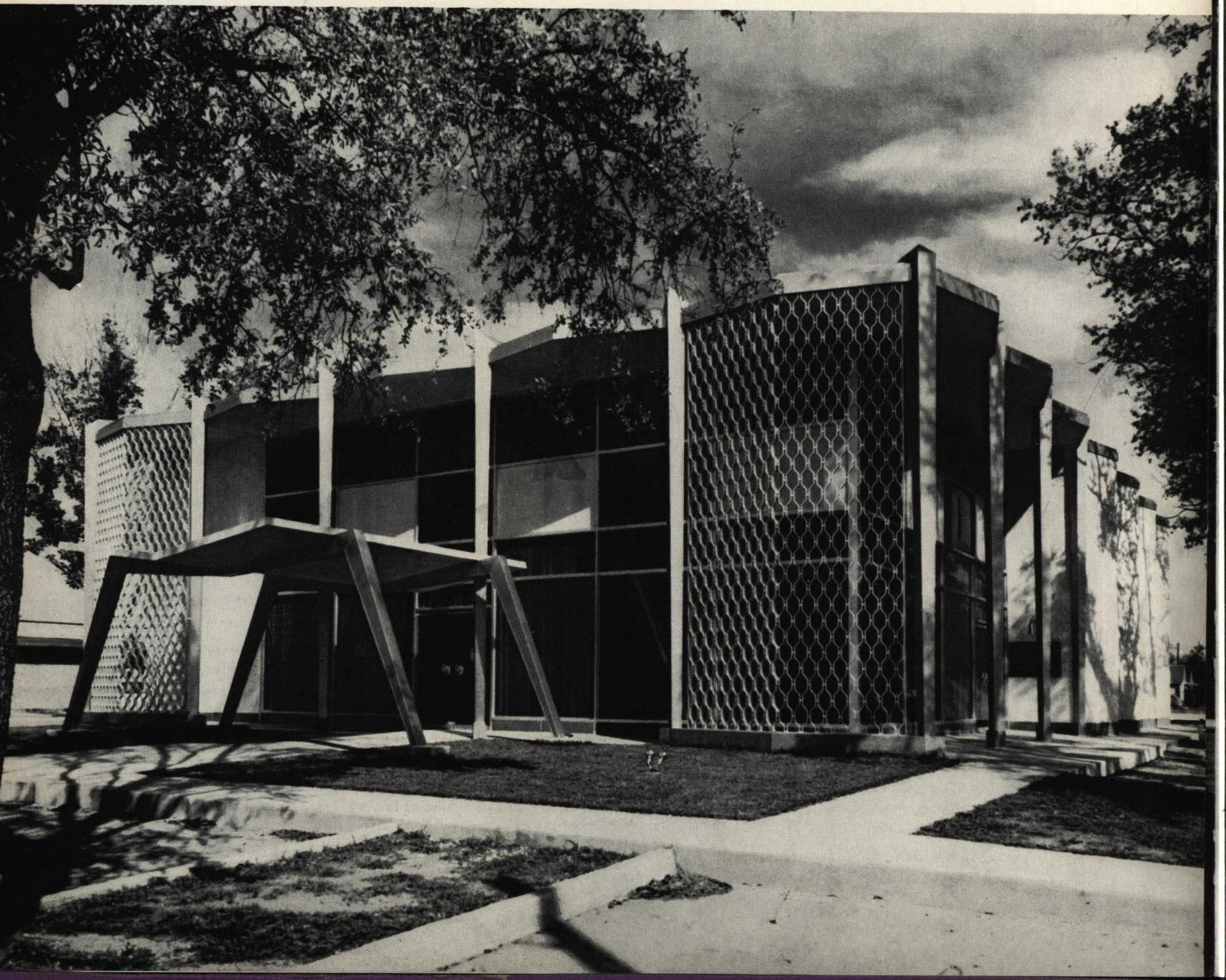
The architects conceived a structure which would look from a distance like "falling leaves suspended in the air". After a thorough investigation, they chose aluminum as the rigid material best able to stand the mechanical strain and the weather. Aluminum sheets in maximum standard sizes suspended from aluminum tube arches form an imaginative type of marquee. Two sheets connected by nine frames form the units of the ceilings. The oversheet is fastened to the frames with pop rivets; the undersheet by point welding. To give variety, the sheets are mounted in three different heights and painted three shades of red – the darkest shade for the highest level, the lightest for the lowest level. Ample dry shelter is provided by these gay ceilings because the sides of the undersheets are turned up and seam welded at the corners to form gutters, the rainwater escaping through two holes in the sides. The total effect is highly delightful as well as efficiently functional. The architect's ingenuity, as well as Oslo's requirements, could well be an inspiration for city planners in the United States.

Calcasieu Marine Bank

Lake Charles, Louisiana

Elwood Reames, Architect

Western Construction Co., General Contractor



The extensive uses of aluminum in this drive-in bank are particularly interesting because in addition to the well-known practical advantages of maintenance, adaptability, and reflective finish, Elwood Reames has made a point of using aluminum to suggest the purpose of the building. He chose gold anodized aluminum for columns and canopy supports, with natural aluminum for the sunscreens, glass settings and cornice fascia because it would sparkle in the sunlight and bring to mind the associations of gold and silver with banking. The highly finished aluminum provides a pleasing contrast with the rough texture of the shell stone used for the masonry portions of the structure; this type of stone being similarly appropriate because the marine life visible in it suggests the name and history of the bank.

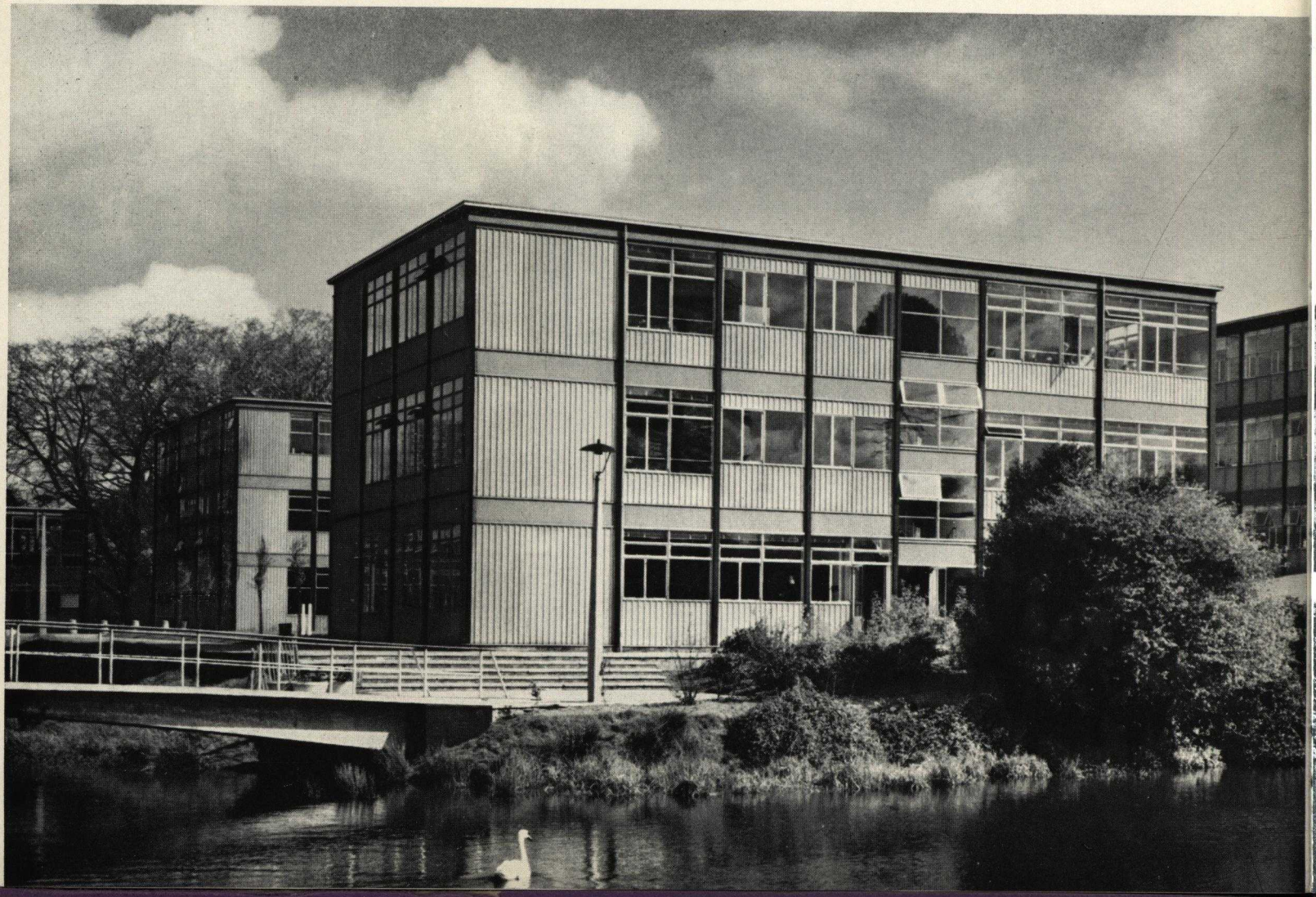
The western orientation of the building on the 150 x 200-foot lot was the most suitable for commanding public notice from the busy street corner and for providing maximum parking space. However it required stringent sun control measures. By careful arrangement of the overhangs of the roof and use of porcelain aluminum panels, tinted glass, and aluminum sunscreens, the sun is eliminated from all working areas during all working hours. These solar devices naturally have influenced the form of the building itself, creating a decided contrast to the prevailing rectangular style of today's architecture. Its dramatic shape is somewhat reminiscent of one of nature's storage vaults, the beecomb, so that the banking function has been expressed in form as well as in choice of materials.

Left This view shows how the tapered gold anodized aluminum columns and canopy supports, as well as the pointed overhangs and canopy, depart from the familiar rectangular facade pattern of contemporary bank buildings. **Right** The bank's interior is quiet and cool because of the exterior sun control devices. The uncrowded public space with a high ceiling provides a flattering and friendly atmosphere for the transaction of banking business. Aluminum is used extensively here, in balcony railings, handrails, various fixtures, and furnishings because of its high finish, flexibility and excellent wearing quality.

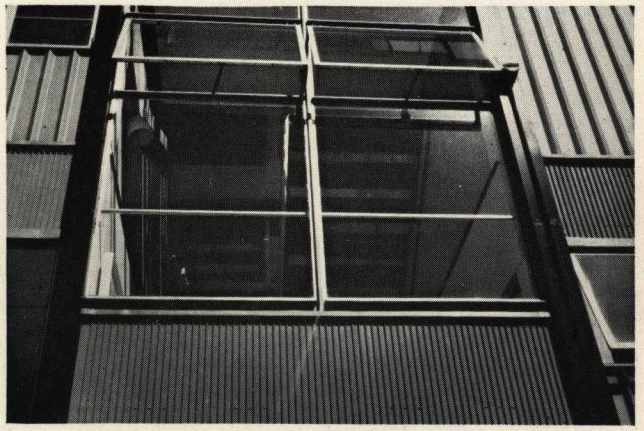
Whitley Abbey Secondary School

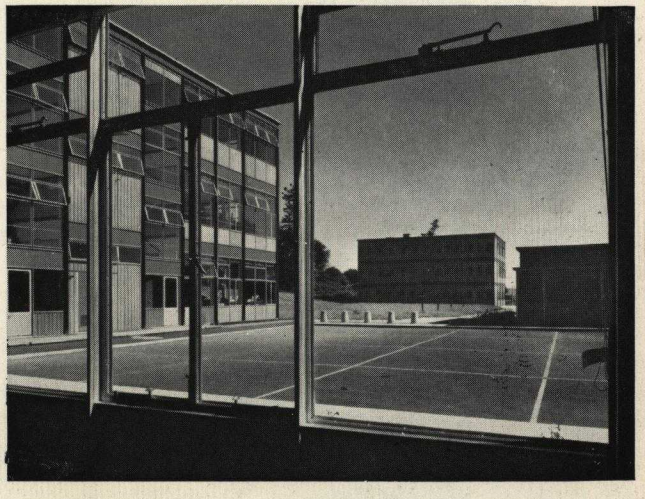
Coventry, England
Arthur Ling, Coventry City Architect
W. A. James, Architect-in-Charge

Located on the site of an ancient medieval abbey, Whitley Abbey School was designed as a prototype of modern construction methods. This building complex is located beside a beautiful lake, on acreage carefully landscaped over the centuries. The property, steeply contoured and thickly wooded, heightens the effect of the highly civilized, crisply styled architecture. Providing secondary school facilities for 1,650 boys and girls, the informally grouped building blocks are sheathed with unusually handsome aluminum curtain walls. These include single-story residences, a series of multi-storied teaching blocks, and a central building containing main hall, music room, library, gymnasium, and administrative offices. As a trend-setting school, Whitley Abbey in Coventry is an outstanding combination of modern design and materials handled in a way that meets modern educational needs efficiently and eloquently.



Below left All of the buildings of Whitley Abbey are designed on a 4-foot grid according to a basic system of construction. This system was developed with the Bristol Aeroplane Co. Ltd., by the Ministry of Education Development Group and the Coventry City Architect's Department, to meet the shortage of schools in England. It combines the economics of prefabrication with the opportunity for a happy variety in the detailing of each facade and organization of each building. The main teaching block is seen to the left, the craft block to the right. **Top right** External walls are formed of prefabricated aluminum panels. These consist of rolled or extruded aluminum sections which support sheets of 20-gauge aluminum with a special finish. The sheets are insulated with glass wool and lined on the interior with building board. In window units, a portion of the aluminum sheet is replaced by aluminum-framed glass. **Middle right** This photograph shows a close-up of one of the window panels. In one-story buildings, the edge members of the panels are structural and support the roof beams. In the multi-story buildings they are thinner in section, designed to resist only the lateral pressures of the weather. The structural weight is carried by conventional frames. **Right bottom** Precisely detailed aluminum window frames, as shining as the glass they enclose, have both vertical and horizontal opening sections.



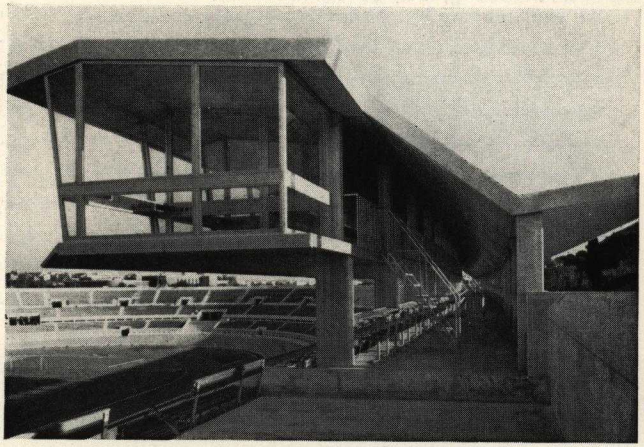


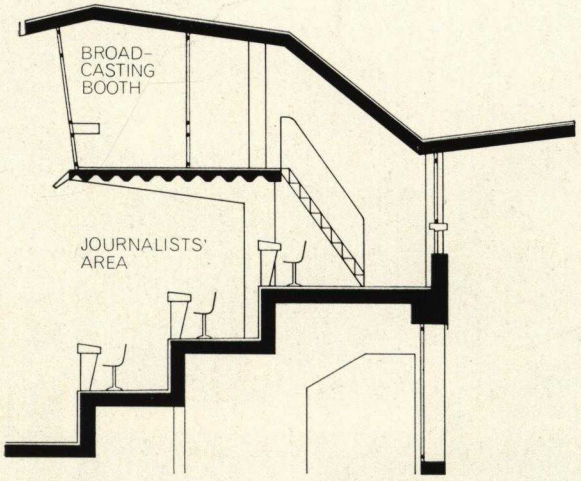
Press Section, Olympic Sports Stadium

Rome, Italy

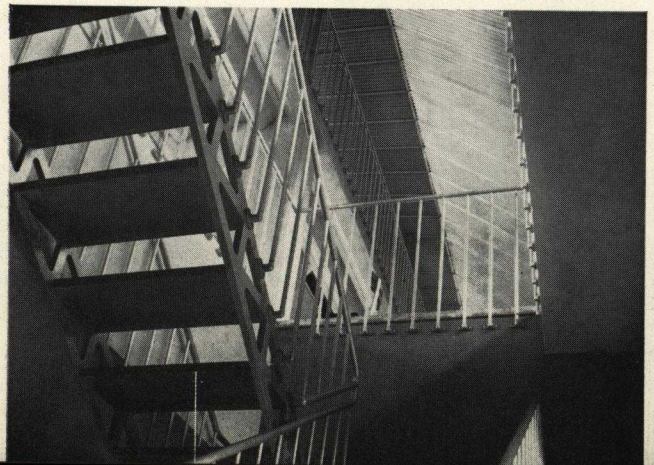
Annibale Vitellozzi, Architect

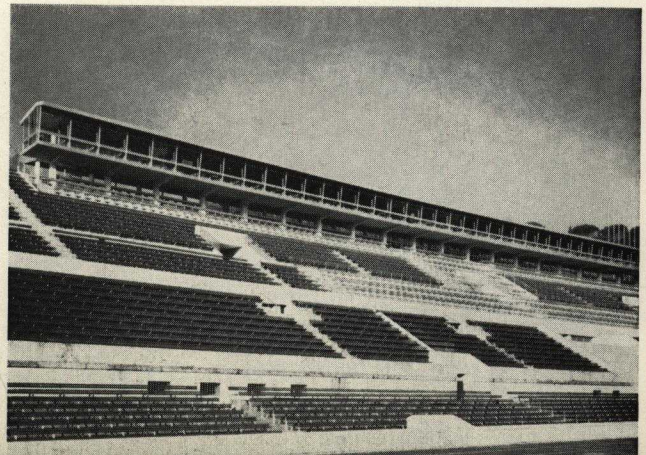
Grandeur, the favorite word for ancient Rome, is the appropriate word for this modern Roman stadium in its stunning panoramic setting. Its facilities are as modern as the Olympic Games are ancient. In the Stadium's Press Section, 580 journalists from all over the world are provided direct access to press rooms, teleprinters, telephotos, post office, and telegraph offices, as well as special desks, comfortable chairs, and an unobstructed view of the games. Architect Annibale Vitellozzi has employed aluminum extensively in the Press Section to contrast with and dramatize the bold concrete forms of the stadium itself, designed by the internationally celebrated engineer, Pier Luigi Nervi. Vitellozzi designed a sleek-looking aluminum roof that is superbly fabricated and aluminum partitions which contain efficient heating equipment. He designed everything from aluminum chairs and tables to stairs with maximum efficiency, as well as using the material in many standard applications to produce a light, weather-resistant superstructure that is remarkably functional in design and gleaming in appearance.





Far left The Olympic Stadium Press Section at left overlooks the entire sports arena. **Above** This end view shows its ingenious and efficient structure as well as its open precise appearance which contrasts with the rugged and bold concrete work of the stadium itself. The internal partitions of the press rooms are of glass and aluminum, compactly designed to contain all necessary heating equipment. Tube and extruded aluminum are used in the windows, internal doors, grilles, and traffic-dividing rails. **Left** Cross-section of the press facilities reveals the weight-bearing aluminum structure of the journalists' seats and tables. Note how the press rooms shade the work desks. Thick cork insulation fills the empty voids between the roofing supports. The roof is faced with anodized aluminum. The total absence of visible screws over such a considerable area is made possible by setting all the final closure elements in place under pressure so as to form a homogeneous unit. **Below left** The crisply styled aluminum stairs connect the Press Section with the broadcasting booths. They are composed of single-piece lattice beams and treads of extruded sections. **Below right** This athlete's view of the forty rooms, where the press covers the important national and international sports events held in this stadium, shows the unobstructed observation point provided by the Press Section's location and design.

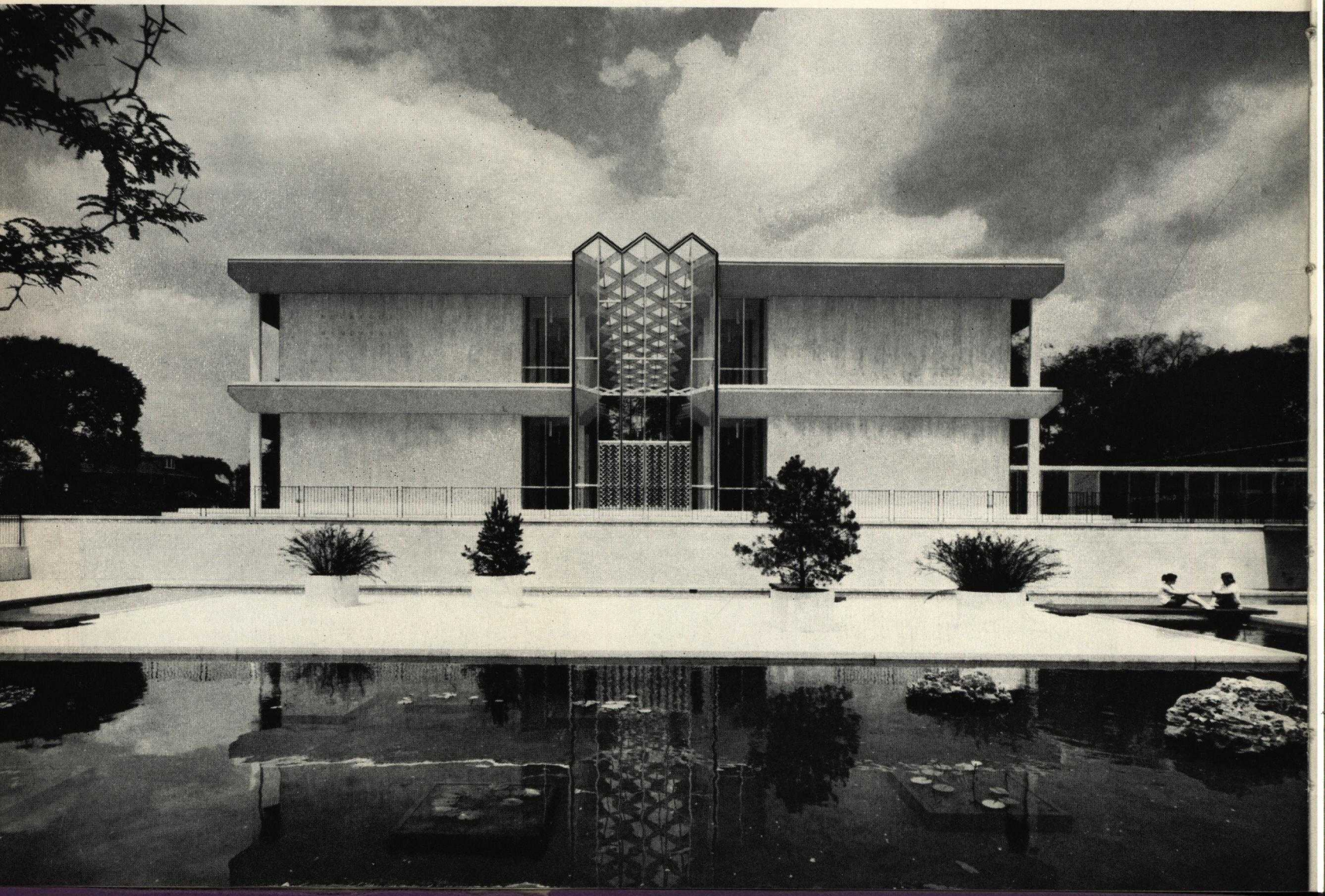




McGregor Memorial Conference Center

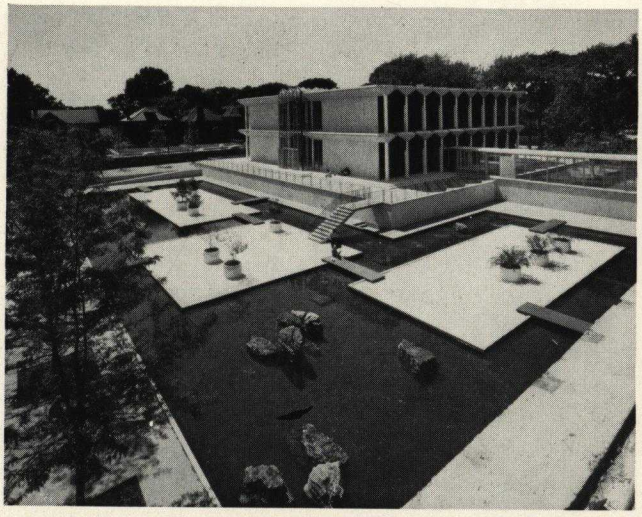
Wayne University, Detroit, Michigan
Yamasaki, Leinweber & Associates, Architects
Darin & Armstrong, Inc., General Contractors

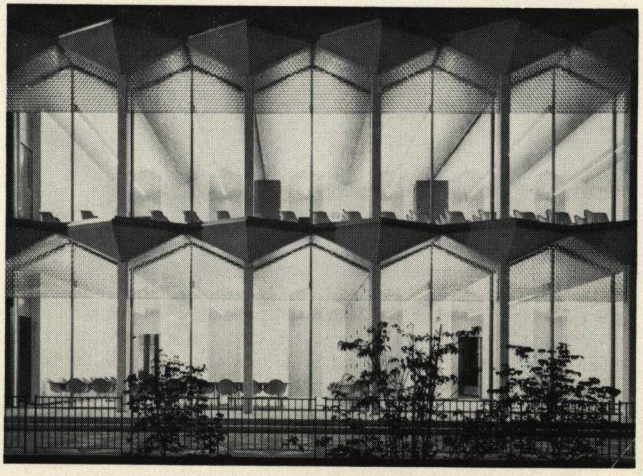
Below The richness and solidity of the pure white, travertine marble facade is heightened by the contrast of the jewel-like, two-story aluminum and glass central hall which centrally divides it. The aluminum-framed skylight and the entrance doors of heavy aluminum, intricately sculptured by Lee Du Sell, prove that an expression of lightness can be the result of precision in architecture. **Right, above** The formal garden includes a reflecting pool and several slab islands with rocks and plants carefully selected for their shape and appearance. It is skillfully composed to provide a congenial environment for the Memorial Center and to separate it from neighboring structures. A pleasant place to walk, relax, and converse, it will eventually include several pieces of sculpture. **Right, bottom** The two rows of triangular peaks and slender columns are dramatized in this view of the west facade illuminated at night. The upper portions are veiled with honeycomb sunscreens of extruded, gray, anodized aluminum. **Far right** Handsome stairs lead from the central hall to the second story. The aluminum-framed skylight fills the interior with brilliance at both levels. The handling of detail and the selection of rich-looking materials gives this building a rare and practical appearance.



In a period of confusing architectural aims, there is no doubt about the objectives of a talented architect from Detroit. Minoru Yamasaki aims to create an "architecture of delight". It would be difficult to find a more perfect statement of this than the precisely designed Memorial Conference Center at Wayne University's mid-Detroit campus. Yamasaki believes that every building should have a quality that goes beyond good planning and good detailing – a quality amounting to an emotional experience. This, he maintains, should be determined by the idea of the building which must come first in the designing process. Only afterwards can the proper materials, the most fitting module, and other architectural elements be selected to express it.

In the McGregor Memorial, the architect has employed unusual methods to contribute to the overall impression of contemplative elegance. The pleasure of coming from one of the conference rooms with a normally low ceiling into the two-story central hall crowned with an aluminum and glass skylight has been considered as a spacial experience. The landscaped garden and reflecting pools express meditation and privacy. The white marble, shining aluminum and gleaming glass used in the facade express purity and richness. The slender structural columns and peaked window bays express grace. The slim lines of the aluminum elements used in the skylight frames, in the two-story window cage at either end of the central hall, in the netlike aluminum sunscreens that hood the windows, and in the sculptured mesh of the aluminum doors express delicacy and subtlety. The whole building, a symbol of educational ideals, has been described as a landmark in educational architecture.



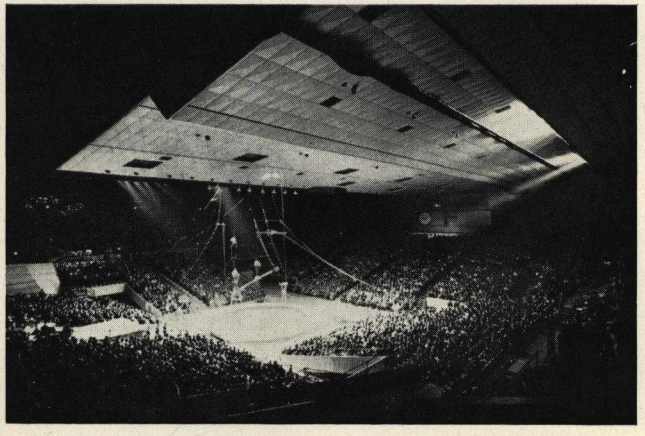


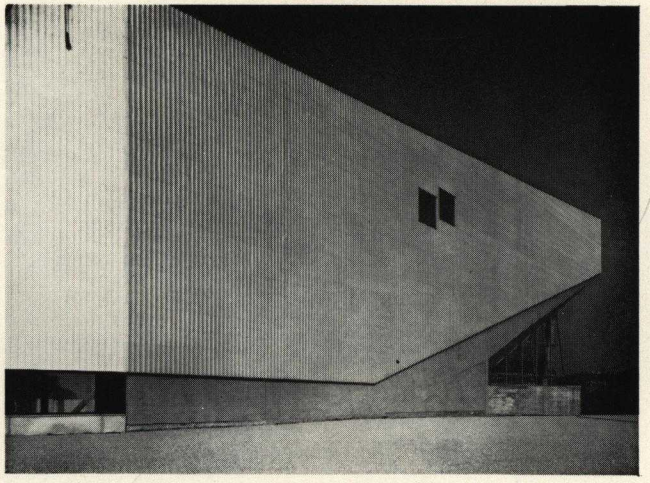
Municipal Hall

Vienna, Austria
Roland Rainer, Architect

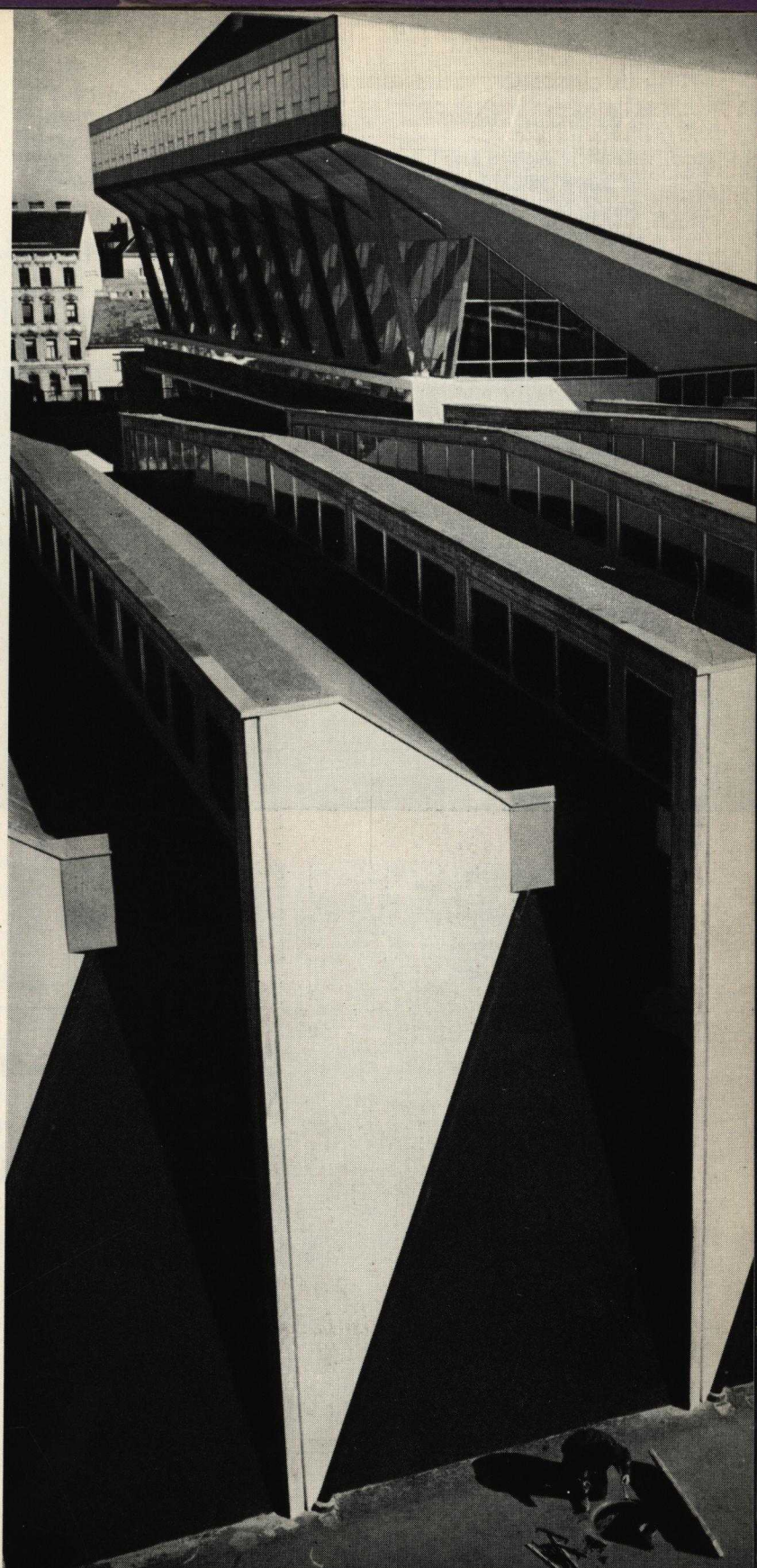
Difficult design problems posed by the municipal arena received one of the most flexible and beautiful solutions in Vienna's new amphitheater designed by the noted Austrian architect, Roland Rainer. It is no easy trick to provide facilities for bicycle races, concerts, boxing matches, exhibitions, ice skating, theatre, basketball games, conventions, fairs, bowling, and movies in a single building. It is even more difficult to prevent that building from being the frequently massive municipal eyesore. Rainer combined an extensive use of aluminum with a strikingly functional concrete form to create a building that looks half its size and half its weight. Aluminum-framed windows and a glistening aluminum facade give the viewer the impression of an almost weightless surface.

The interior is a model of efficient planning. The huge hall can be altered quickly in a dozen different ways to accommodate its many needs. The interior space is unified by a great aluminum ceiling which slopes dramatically toward the center to accommodate the 328-foot hip trusses that span the roof. If the space had been roofed in the traditional manner with a dome or barrel vault, distances from the source of light to the arena would have been excessive. The curtains would have had to be very high, the space difficult to heat, and the acoustic problems all but insurmountable. Most of all, however, the hall would have tended towards oppressive giantism. With imaginative use of aluminum inside and out, Professor Rainer has designed a great community center in keeping with the spirit of recreation and entertainment.

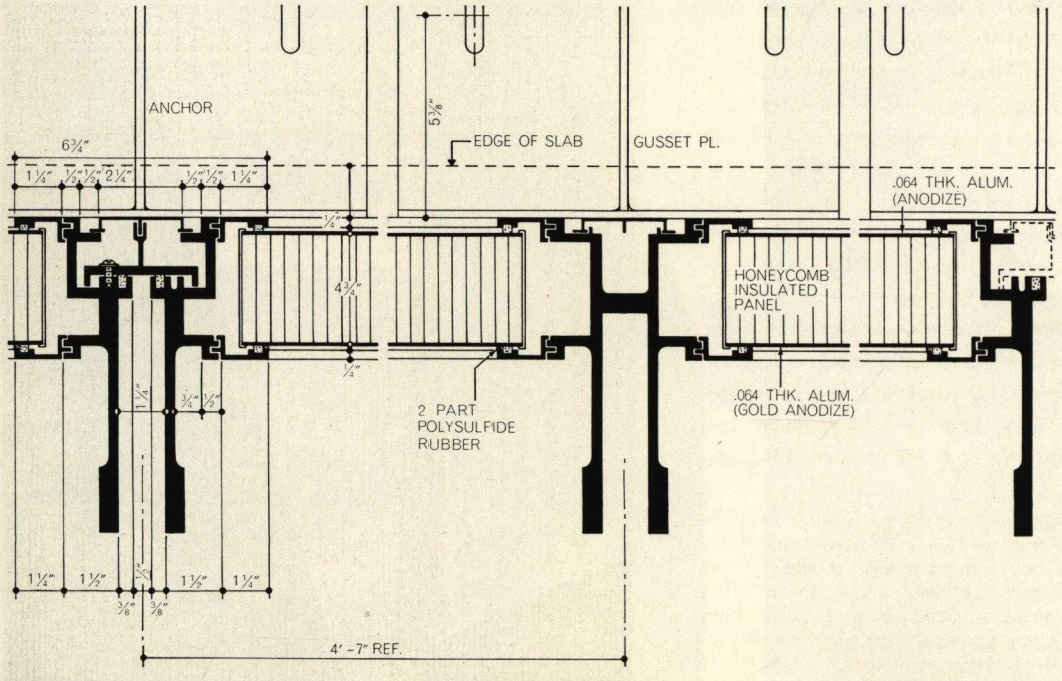




Above left Approach to side entrance of the amphitheater is convenient by automobile. **Below left** The great perforated aluminum ceiling, suspended from the huge roof trusses, dramatically reflects the arena lights. Aluminum proved the ideal material–lightweight, fire-resistant, workable, and economical. **Above** The anodized natural-colored aluminum siding and an unusual concrete form give the huge building a light, dramatic appearance in keeping with its theatrical and spectacular purposes. **Right** Precise aluminum and glass windows open up the ends of the arena. **Far right** Sawtooth roof with aluminum-framed windows floods the sports building with light.



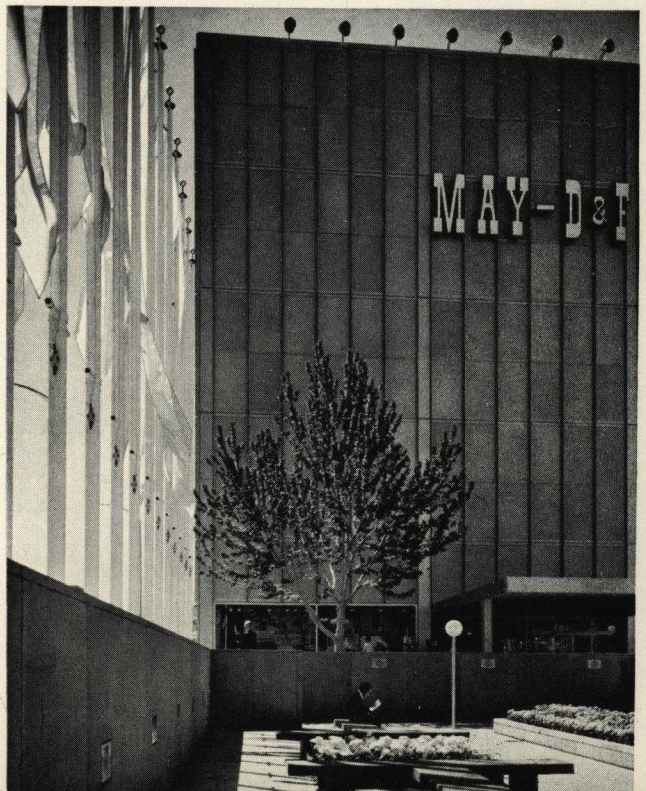
MAY-D&F


ANCHOR
6¾"
1¼"
½"
½"
2¼"
½"
½"
1¼"
5⅛"
EDGE OF SLAB
GUSSET PL.
.064 THK. ALUM.
(ANODIZE)
¼"
4¾"
¼"
HONEYCOMB
INSULATED
PANEL
1¼"
¾"
½"
2 PART
POLYSULFIDE
RUBBER
.064 THK. ALUM.
(GOLD ANODIZE)
1¼"
1½"
½"
1½"
1¼"
⅜"
⅜"
4'-7" REF.

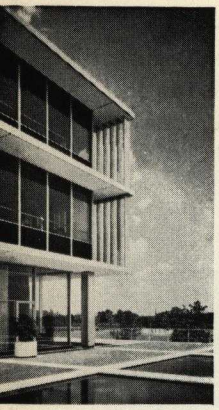
May — D & F

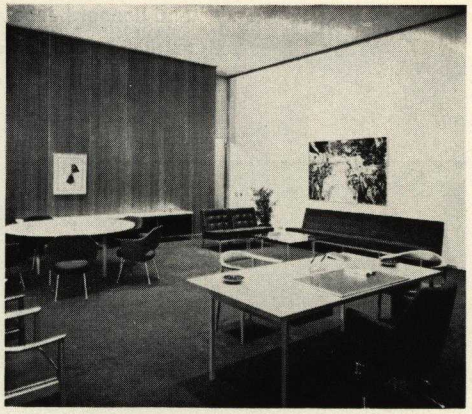
Court House Square Development, Denver, Colorado
I. M. Pei & Associates, Architect, with Henry N. Cobb, Designer
and Leonard Jacobson, Coordinator
Webb & Knapp Construction Corp., General Contractor

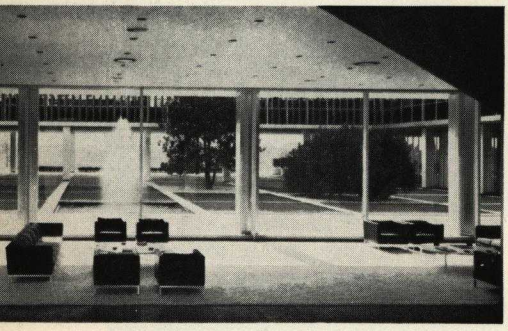
I. M. Pei has designed for William Zeckendorf a suburban-style shopping center located right in the busy midtown section of Denver, Colorado. A dramatic hyperbolic, paraboloid shell structure serves as an accessory shop and main entrance to the four-story main building which is completely encased in a curtain wall of light gold anodized aluminum. For autoists, there is a three-level underground parking facility and for pedestrians' enjoyment, a spacious plaza with shade trees, and skating rink that serves as an outdoor restaurant in the summer-time. The vestibule of the plaza shop, its link to the main building and the main entrance canopy are of the same golden-hued aluminum. Store fronts and doors as well as the stems and brackets of the plaza's light fixtures are of natural-color anodized aluminum. This store deserves the attention it attracts by offering both customer and passerby the pleasures of suburbia and convenience of the city.

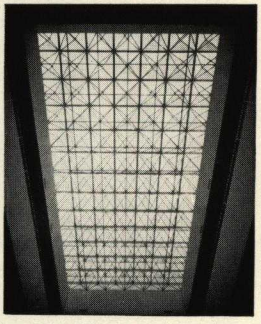


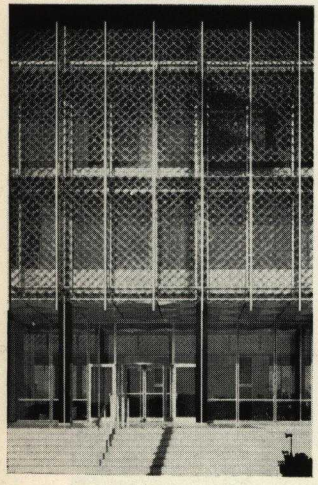
Left This general view shows the gleaming shopping center in Denver's 35 million dollar Court House Square project, with its honey-colored curtain wall detailed below. **Above** Honeycomb panels of aluminum-faced paper set in frames of extruded aluminum which attach directly to the building structure without subframing are lifted easily into place. **Right top and bottom** Two views across the generous plaza reveal the impressive size of broad mullion-ribbed anodized curtain walls.











Reynolds General Office Building

Richmond, Virginia
Skidmore, Owings & Merrill, Architect & Interior Designer
Ebasco Services, Inc., Facilities Planning, Engineering & Construction Management.
George A. Fuller Company, General Contractor

Reynolds Great Lakes Sales Region Headquarters Building

Detroit, Michigan
Minoru Yamasaki & Associates, Architects
Darin & Armstrong, General Contractor

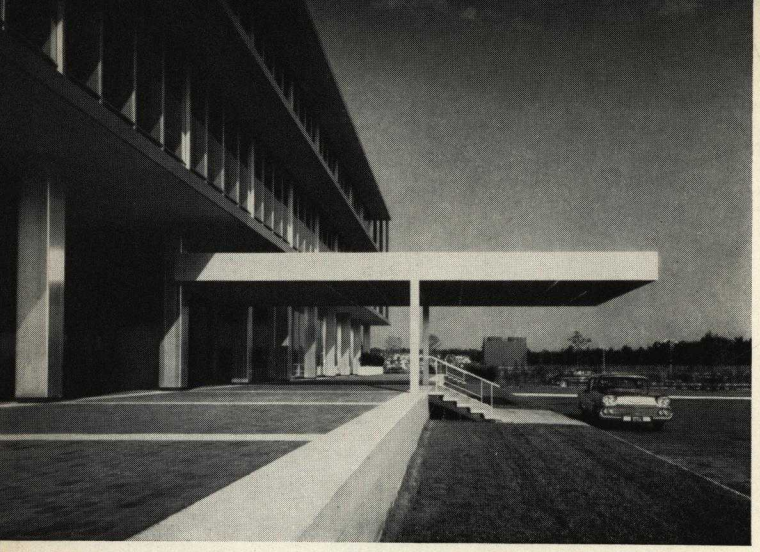
At a time when a corporate image is reflected in the gleaming facade of a company's architecture, the Reynolds Metals Company has erected two buildings widely acclaimed for their precision, imagination, and style. Both were designed by architectural firms of international reputation–the new General Office Building in Richmond, Virginia, by Skidmore, Owings & Merrill, and the Great Lakes Sales Region Headquarters Building in Detroit, Michigan, by Minoru Yamasaki. Both are dramatic showcases for architectural aluminum. Yet it would be difficult to discover two modern buildings of the same material more different in atmosphere and appearance.

The multi-million dollar General Office Building, capable of housing 1000 employees, is located on 160 acres of rolling Virginia countryside. The huge four-level structure, designed with all the style and precision for which Skidmore, Owings & Merrill are famous, contains over 1,235,000 pounds of aluminum.

From the exterior, virtually everything that meets the eye is either aluminum or glass. The long window walls on the entire eastern and western sides of the building, as well as those of the inner court, are shielded by the largest sun louver system in the world. Here 880 lightweight aluminum louvers, each 14 feet tall and 22 inches wide, rotate to an astronomical clock and will anticipate the movements of the sun through the year 2100 A.D.

Aluminum's propensity for exact and economical forming by extrusion is demonstrated in everything from mullion covers to file drawer handles. On the exterior, major applications of aluminum include glazing stops and trim, black anodized spandrel

Left, top to bottom East facade of Reynolds General Office Building in Richmond, Virginia; President's modern office with informal conference area; General Headquarters Reception Lounge; Dramatic skylight of the Detroit Great Lakes Sales Region Headquarters Building; Main entrance of the Detroit office. **Far right** A lively fountain and stately southern magnolia are seen against the aluminum and glass walls in the spacious center court of the Richmond building.



Left The main entrance to the Reynolds General Office Building is dramatized by an aluminum canopy. The strength of the I-beams and the light weight of the canopy demonstrate two of the metal's characteristics.

Left This view of the Richmond reception lobby, looking toward the executive offices, shows its open relationship to the central court. Both the floor of the lobby and terrace are paved in traditional southern brick.

Left The executive dining room features modern furnishings, modern paintings, and fine food. It looks out through huge glass walls onto a pastoral view of the Virginia countryside.

Fold out this page for general view of the Richmond Office Building. →

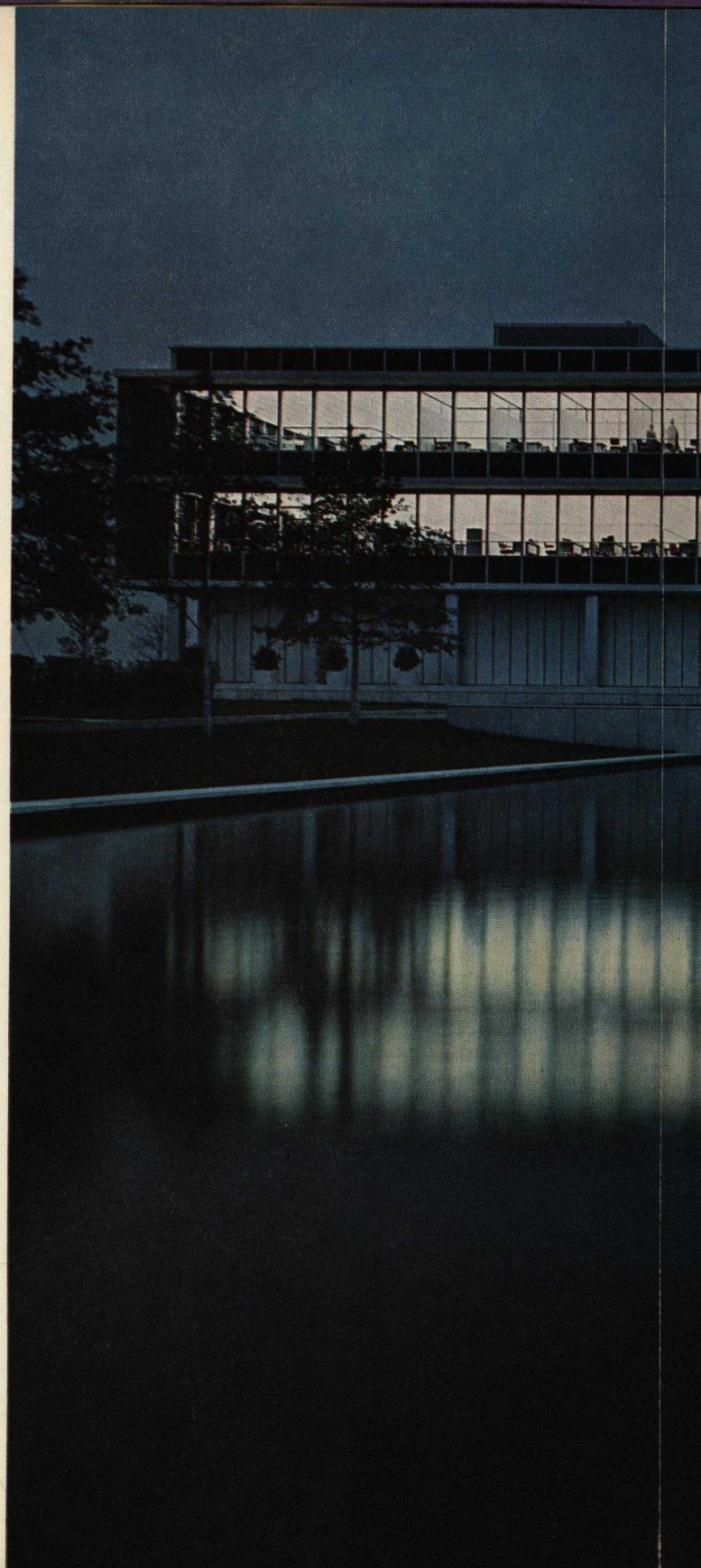
panels, fascia and coping, rain leaders which run down inside the mullions, flashing, canopies, column covers, door frames, including hardware and thresholds, paneling, convector boxes and covers for perimeter heating. Interior uses of aluminum include the world's largest aluminum honeycomb panel ceiling, and 32,000 square feet of aluminum acoustical ceiling, ductwork, insulation, aluminum wiring, electrical fixtures, elevators, moving stairs and overhead and sliding doors.

The Great Lakes Sales Region Headquarters Building, designed to demonstrate the beauty and utility of aluminum, has been described as a modern architectural gem. The building, a sparkling example of Yamasaki's "architecture of delight", is a jewel on stilts, designed to catch the eye of the passerby in the heavily trafficked northwest area of Detroit.

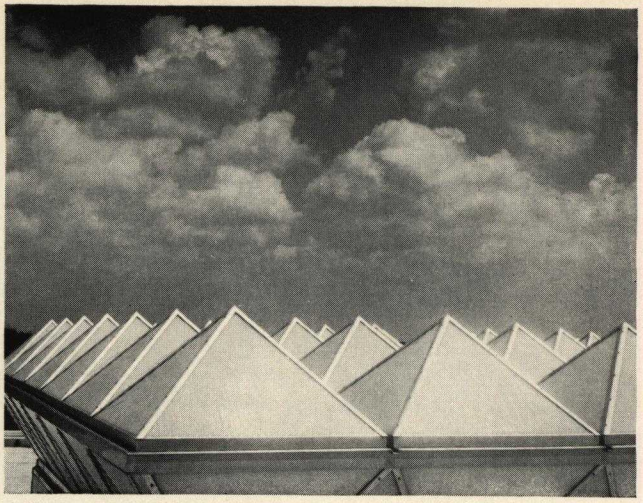
It is a three-story rectangle, containing sales offices and showroom, placed on a podium surrounded by a reflecting pool. The first floor is open while the second and third floors are shielded on all four sides by a gold anodized aluminum sunscreen. The screen consists of 10-inch diameter rings, 2 inches deep, locked together mechanically in a selected pattern. Above the 7-foot height, the rings are 14 inches deep, which together with the walkway gratings at the windows, cuts off the rays of the sun except when they are at a very low angle.

The lightness and strength of aluminum permitted economical shipping and easy handling of the screen, which was factory assembled in 5-foot by 13-foot panels. It was the answer to the problems of the exposed site, but it was also an answer to the designer's long-standing desire for machine-made ornament which could be used to enrich modern architecture.

However, this exterior splendor in no way prepares the visitor for a pleasant architectural surprise on entering the building. From the first floor to the roof is an open well area covered with a diadem skylight of aluminum and glass, described by the architect as a "space frame divided into 91 pyramid-shaped structures whose many sides glisten like jewels in the sunlight". By day, natural light floods the interior, while at night, the building appears a brightly glowing lantern on the landscape. Aluminum was used less dramatically but effectively in the building as formed ceiling pans, in luminous ceilings, grilles, doors, window sashes and gratings. This bright showcase for aluminum is worthy of both the architect and his material.



Right Mirrored in the 250-foot long reflecting pool, the General Office Building is a shining example of classical modern design.



Left The elegant materials, marble, glass, black, silver and gold anodized aluminum typical of the Reynolds Great Lakes Sales Region Headquarters Building can be seen in this photo of the southwest corner. At left is a portion of the ground floor reception and display area and at the right, the reflecting pool. **Above left** This typical office contains modern aluminum furniture and shows the sunscreen from the inside. **Above right** Ninety-one glass and aluminum pyramids form this unusual skylight. **Below** Seen from the Northwestern Highway, the building with its golden screen has already become one of the architectural conversation pieces of Detroit, the motor city.

Corrosion and Aluminum

Twelve questions and answers on one of modern architecture's most misunderstood subjects by a panel of experts representing the aluminum industry.

WHAT IS CORROSION?

Strictly speaking, corrosion is the destruction of metals and alloys by electrochemical reactions. For practical purposes, it might be described as the degradation of metals by their environment.

Aluminum is distinguished from other common metals by its remarkable affinity for oxygen. This results in a hard, thin, tenacious, glass-like oxide film being formed instantaneously on its surface when exposed to the atmosphere. This film not only protects the metal from further oxidation but gives aluminum its unusual ability to withstand weathering or corrosion caused by natural atmospheric conditions.

The atmospheric corrosion of aluminum is generally insignificant from a strength standpoint but the architect may feel that even small amounts of corrosion might mar the aesthetic values of his structure. This concern for permanence of the beauty of original finish can be resolved by good design and the use of various finishes. These precautions, which are simple and inexpensive, result in a long maintenance-free life.

IS RUST JUST ANOTHER NAME FOR CORROSION?

There are no metals that do not corrode under some conditions. The corrosion product of iron and steel historically has been called rust and consists of a voluminous, ill-appearing mass of red iron oxide. The corrosion product of aluminum is a white oxide, usually found in small amounts because the reaction tends to be self-limiting.

WHY DOES ALUMINUM RESIST CORROSION?

The resistance of aluminum alloys to corrosion depends on the presence of a very thin film of aluminum oxide that protects the metal surface. This inert film forms immediately upon the metal when it is in contact with air. At room temperature the naturally occurring oxide film rarely exceeds a thickness of 50 millionths of an inch. At higher temperatures a somewhat thicker protective oxide film occurs. This extremely thin protective film effectively halts further atmospheric oxidation of aluminum, and prevents or slows down chemical reaction between aluminum and the chemicals found in marine and industrial environments. Furthermore, this natural film is capable of repairing itself. As the protective oxide film is damaged by chemical or mechanical action, a new film will form over the exposed metal, provided there is sufficient oxygen present in the environment. This is true in atmospheric exposure conditions as well as in many applications in sea water, fresh water and in chemical plants. The oxide film protects the metal surface under extremes of temperature conditions and remains intact even at the melting point of aluminum.

HOW CAN CORROSION BE DEALT WITH IN STRUCTURES USING ALUMINUM?

Among the many favorable characteristics of aluminum and its alloys, corrosion resistance ranks as a major factor. In architectural application, the resistance to weathering of aluminum has been recognized for over 60 years. From the first architectural application of consequence, a roof on the San Gioacchino Church in Rome in 1897, the number and variety of aluminum alloy architectural applications have grown to the point where they cannot be cataloged.

It is the purpose of engineers specializing in corrosion and finishing to control corrosion by choosing proper materials and proper finishing techniques as well as by advising appropriate design procedures. This includes the proper selection among an extensive series of aluminum alloys as well as a wide range of aluminum finishes such as porcelain enamel, paint, chemical, electro-chemical and electrodeposited coatings.

The family of wrought aluminum alloys contains eight major divisions with each division representing a different principal alloying element. The grouping is as follows:

SERIES	MAJOR ALLOYING ELEMENT
1XXX	None (99.3 Al Minimum)
2XXX	Copper
3XXX	Manganese
4XXX	Silicon
5XXX	Magnesium
6XXX	Magnesium-Silicon
7XXX	Zinc
8XXX	Other

Among the alloys most commonly employed in the architectural field and building trades are the 1000, 3000, 5000 and 6000 series. These alloys exhibit good to excellent corrosion resistance in industrial, marine and rural environments. Alloys, such as 1100 or 3003, are generally employed where structural strength is not a primary requirement. These alloys are considered to be adequate for all but the most severe conditions of exposure. For exposure to marine environments, aluminum alloys of the 5000 series, particularly 5052 and 5154, offer the highest order of corrosion resistance. In severe industrial or industrial-marine environments, alloys of the 5000 series, such as 5052 and 5154, and the clad alloys, such as clad 3003 or clad 3004, are generally employed. Alloys 6061, 6062 and 6063 are often employed for extruded shapes and offer both strength and corrosion resistance.

Alloys of the 2000 series and 7000 series are sometimes employed in the fabrication of structures because of their high strength characteristics. Except in rural and non-corrosive environments, these alloys should be protected either by cladding or by the application of a protective organic coating.

For architectural purposes, the common alloys (those in the 1000, 3000, 4000 and 5000 series) and the age-hardenable alloys of the 6000 series are used in combination with various finishes to obtain the desired architectural properties.

WHAT IS ANODIZING?

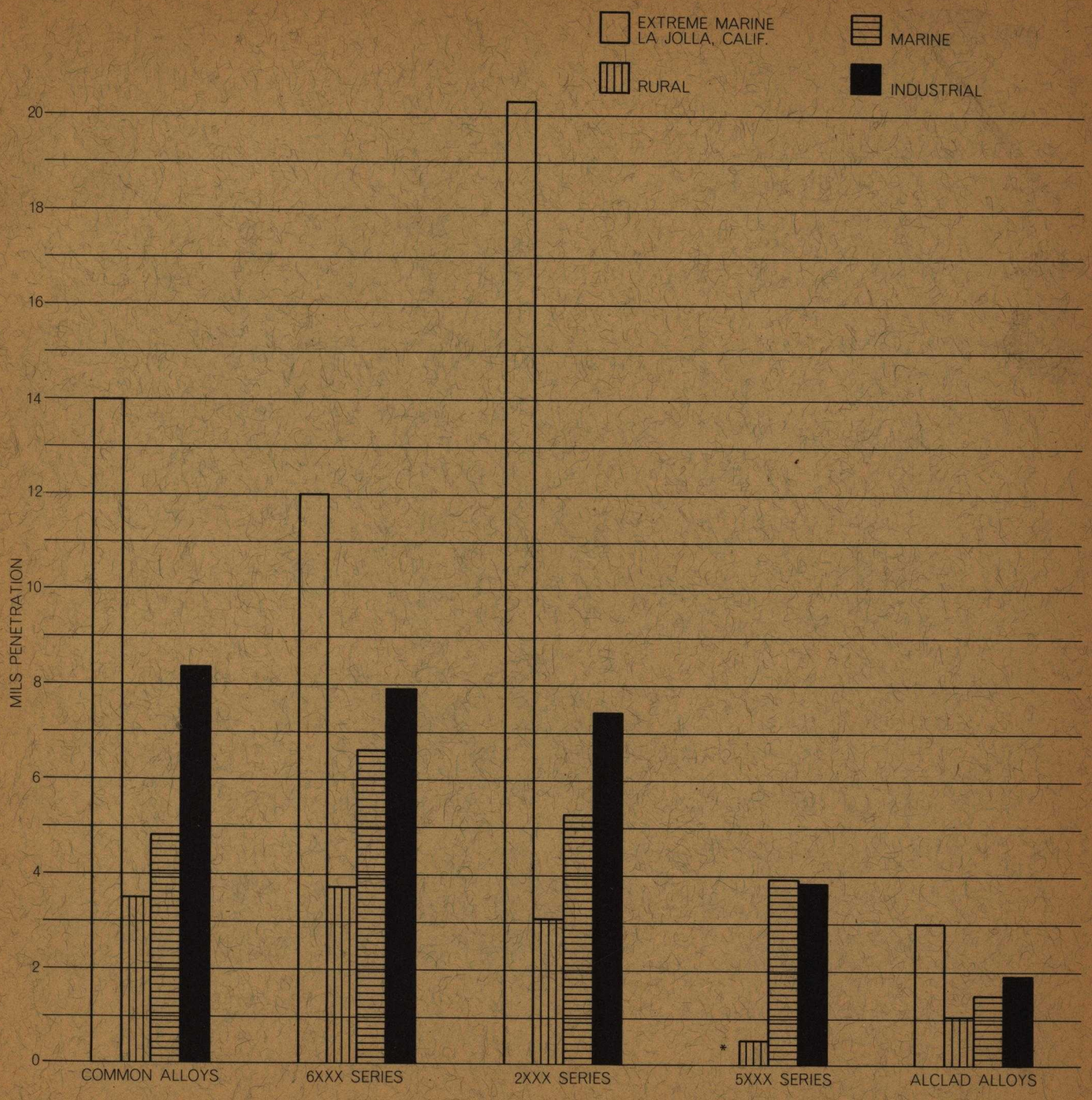
For architectural applications where maximum resistance to weathering and corrosion is required, the natural oxide film which forms on aluminum can be increased in thickness and effectiveness many times over by the electrochemical process known as "anodizing". Anodizing produces a uniform, hard, glass-like aluminum oxide film that is an integral part of the metal surface itself. Its thickness will be from 0.0002 to 0.001-inch. Its natural appearance will vary from that of a clear, transparent coating to a dark, opaque, slate grey, depending on the processing details and the aluminum alloy selected. Architectural aluminum is not only anodized to perform in such a manner that corrosion will not become a problem during its economic life but to increase and preserve the original aesthetic appearance of the structure.

There is, of course, no formula that will keep natural soil and contaminants off the surface. Anodizing will protect the material from corrosion but unless it is periodically cleaned it will accumulate soil. Such a maintenance program can be accomplished at the time the windows are washed . . . or at longer intervals. Cleaning will also protect the original beauty of the anodized finish by preventing deteriorating influences from building up on the surface.

The life of an anodic film is dependent upon its thickness. Judging from experience, a film of .0008-inch exposed to exterior atmosphere can reasonably be expected to last approximately twenty years or longer, whereas a film of .0002-inch may fail within the first two years even with good maintenance practices.

IS IT NECESSARY TO ANODIZE ALUMINUM?

From a utility standpoint, it is not necessary to anodize aluminum surfaces exposed to the weather. However, anodizing is useful in maintaining the original surface appearance, a feature desired on all architectural applications. While the natural oxide film on aluminum is only about 50 millionths of an inch thick, it is perfectly capable of withstanding corrosion for greatly extended periods of time. Even under the most severe conditions – seacoast environments like La Jolla, California – the maximum pit



Maximum penetration in the common aluminum architectural alloy system exposed in rural, marine, and industrial environments–20 years' exposure.

* Alloys of the 5XXX series were not exposed at La Jolla, California.

depth does not exceed .020-inch in a 20-year period in any of the group of aluminum alloys used for architecture. In the usual seacoast or industrial environment, the maximum pit depth does not exceed .014 inches in 20 years.

Applications along highways provide a severe test. Highway guards and bridge railings are exposed to all sorts of weather and get splashed with mud and salt. Without any form of protection whatever, aluminum provides a life of 30-40 years on such applications. For example, bridge railings installed in Chicago in 1928 have greyed over the years but their uniform grey color is regarded as very pleasing. However, if it was desirable to have the bridge rail retain its original appearance, then anodizing would have been required.

For small structures like office buildings and schools, an etched and lacquered aluminum siding has proved economical and highly satisfactory. This film requires periodic replacement as the lacquer weathers away, or the natural protective oxide film will take over.

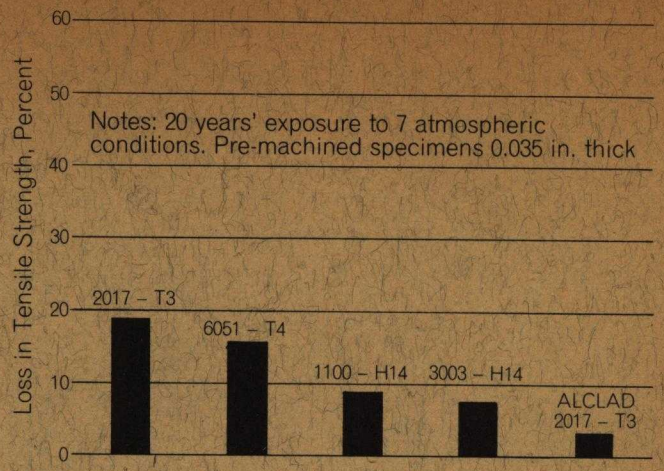
WHAT DOES "ALCLAD" MEAN?

"Alclad" means aluminum clad on aluminum. It might be described as a sandwich of one aluminum alloy on another alloy. It is produced by a metallurgical process in which one alloy layer or slab is laid on a slab or ingot of another alloy and rolled down to the thickness of plate and sheet in a rolling mill at elevated temperatures. The two are metallurgically bonded together, combining the characteristics of both.

The advantages of "Alclad" material depend on the cladding alloy employed. Some claddings are used to provide certain specific finishing characteristics. Other claddings are designed to protect the core material. A good example of this latter is an airplane wing where a very strong but poorly corrosion-resistant aluminum alloy is clad with a relatively pure layer of low strength aluminum which provides excellent corrosion resistance. The combination thus offers great strength with high resistance to corrosion.

ARE THERE OTHER WAYS TO PROTECT ALUMINUM?

Atmospheric corrosion of aluminum is a superficial phenomenon resulting initially in minor pitting or in a general and uniform adherent film of aluminum oxide. It is sometimes necessary to protect the metal surface either to maintain architectural beauty or to overcome some very aggressive chemical conditions which might lead to early deterioration of the surface.



This bar chart shows the relative resistance to weathering of aluminum alloys commonly used in architecture.

Three major types of protection are commonly employed. Where appearance is of primary concern, many architectural items are anodized. Provided the anodic film is of sufficient thickness and is properly maintained (annual or biannual washing with water containing a wetting agent usually suffices), the anodic film will offer protection even under severe conditions of exposure for periods ranging up to 30 or more years. The thicker the anodic film, the longer will be the life of the film.

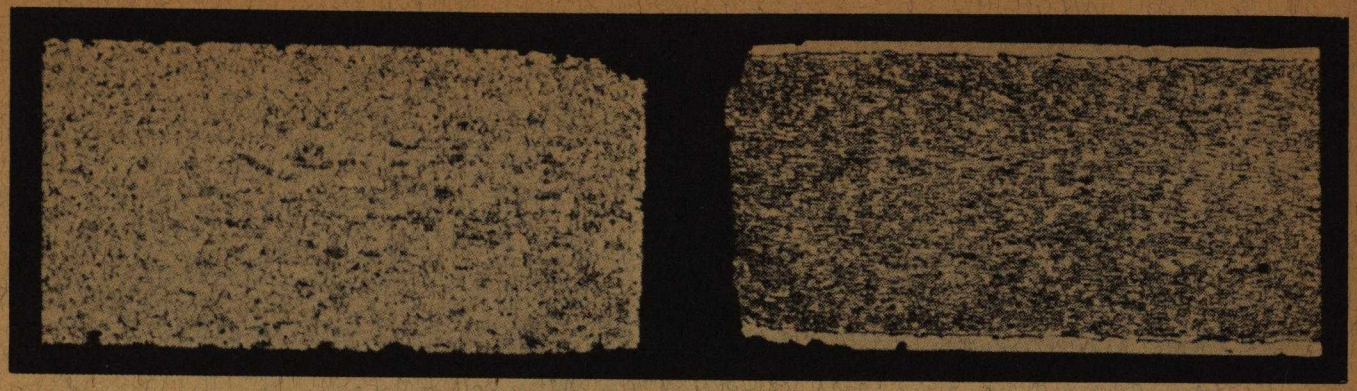
Another means of protecting the aluminum surface and maintaining its appearance is the application of organic coatings, such as paints and waxes. Because organic films are subject to deterioration over a relatively short period of time, it is necessary to replace these films at regular intervals. The life of these films will range from three to six months for most wax-type protective coatings to as much as ten years for certain of the synthetic resins, such as vinyl and epoxy base coatings.

Where aesthetic considerations are not involved, the strength of aluminum alloys in highly corrosive environments can be maintained by the use of clad alloys. Even high-strength aluminum alloys such as 7075 and 2024 are adequately protected by this means. Usually it is not necessary to employ these aircraft-type alloys for ordinary architectural service, for the clad 3003 and clad 3004 alloys will prove to be adequate.

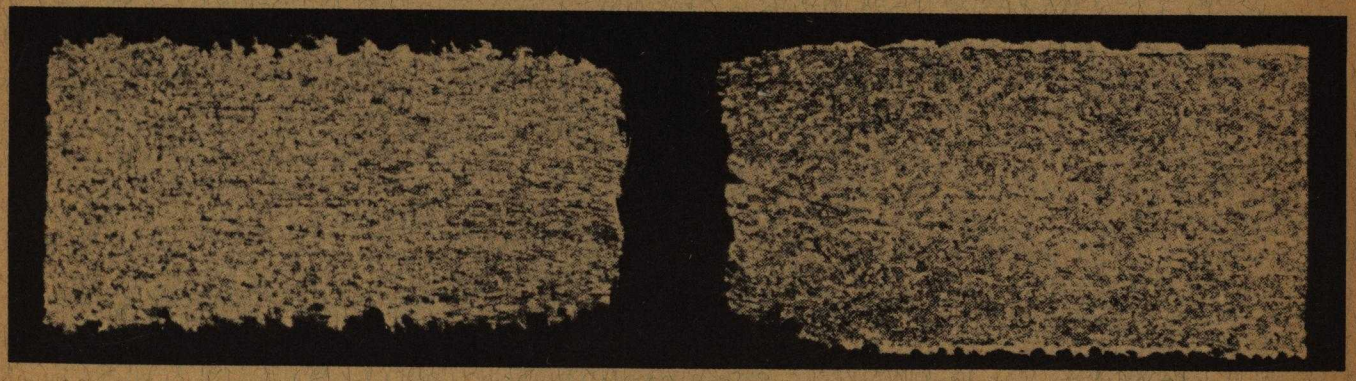
IS THE PROBLEM OF CORROSION INCREASED IF ALUMINUM IS COMBINED WITH OTHER METALS?

Galvanic action, the most common cause of aluminum corrosion, is the result of contact between aluminum and a dissimilar

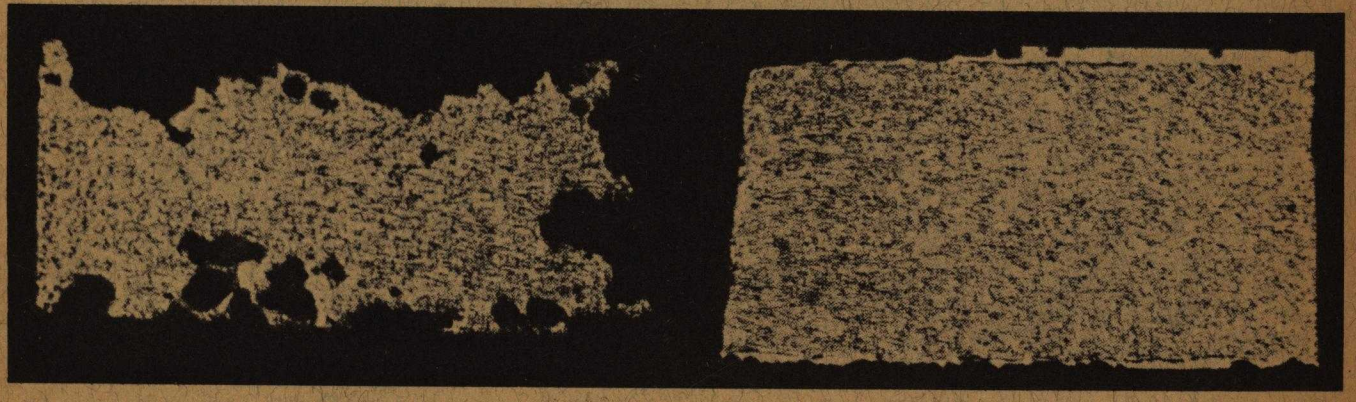
2017-T3 Alclad 2017-T3



State College



New York

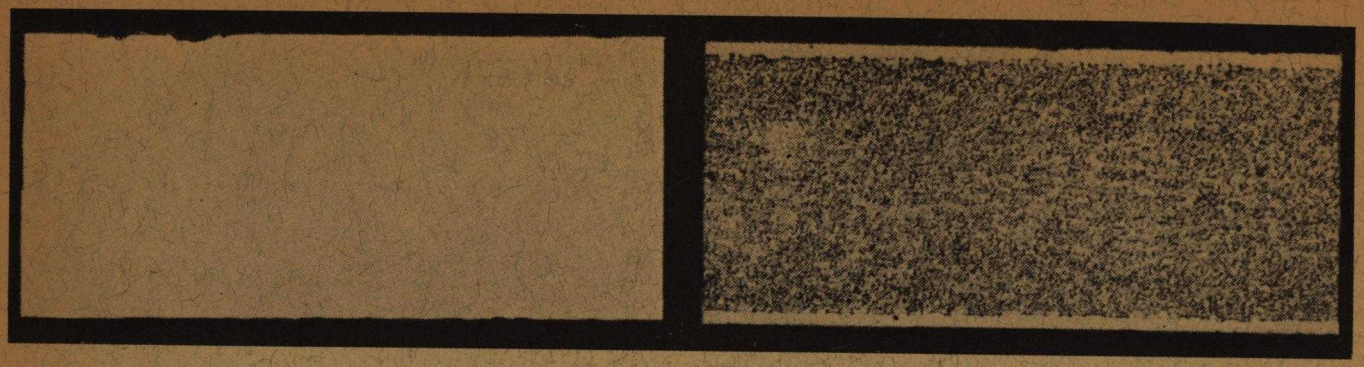


La Jolla

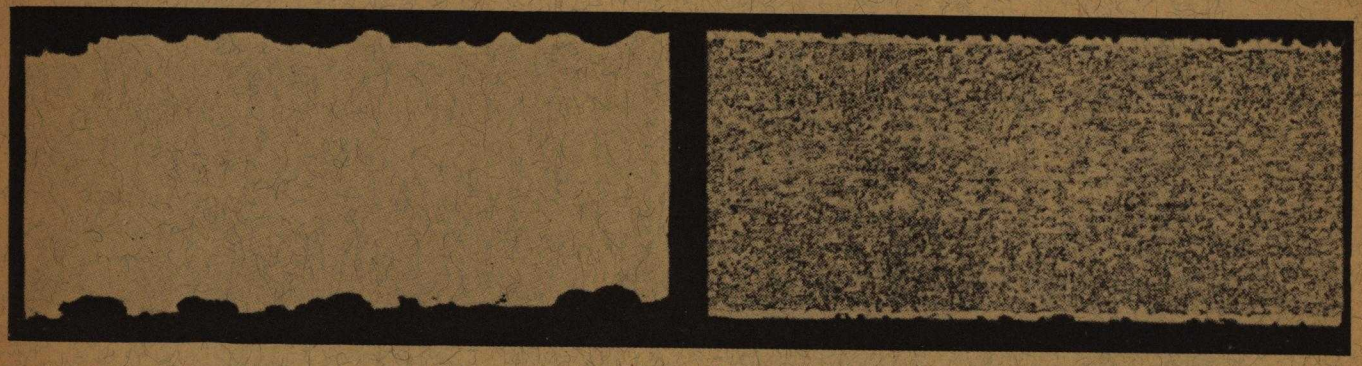
Micrographs showing the surfaces and one exposed edge (center of photo) of 2017-T3 and Alclad 2017-T3 after 20-year exposure. Observe how well the alclad coating electrochemically protected the surface and the exposed edges of the core alloy, the effect being outstanding in the severe seacoast atmosphere.

3003-H14

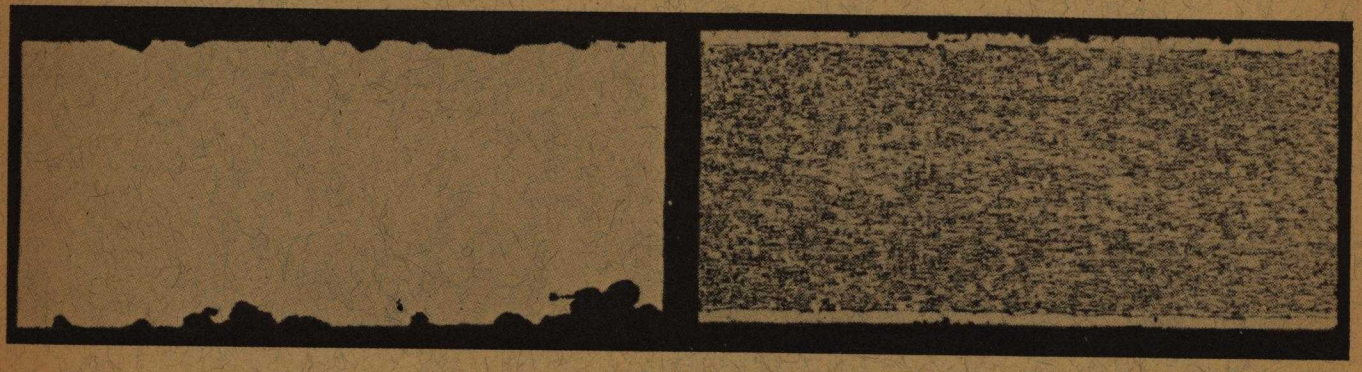
Alclad 2017-T3



State College



New York



La Jolla

Micrographs showing the full thickness of the 0.035-inch thick 3003-H14 and Alclad 2017-T3 alloys, showing the relative amounts of surface attack (away from edges) after 20 years in three types of atmosphere. Attack of aluminum alloys in rural (State College) atmosphere (top) generally was imperceptible. The industrial (New York) atmosphere (center) caused more overall corrosion than a severe seacoast (La Jolla) atmosphere. Note how the alclad coating limited the depth of attack, that considerable cladding remained for continued electrochemical protection of the core alloy, and that this was effected without any increase in corrosion, in comparison with alloy 3003-H14

metal in the presence of an electrolyte (chemicals dissolved in water). Certain dissimilar materials do not initiate corrosion of aluminum, but in themselves suffer accelerated attack when in contact with aluminum. These metals are considered to be anodic. Both magnesium and zinc are in this category.

Other dissimilar metals, such as iron, copper, lead and tin, initiate and accelerate corrosion when in contact with aluminum and are termed cathodic. To protect against, or to eliminate the possibility of galvanic corrosion, one of the following protective measures should be employed:

1. Choose compatible materials of construction. Wherever possible, employ aluminum alloys for fasteners and components.
2. Where it is necessary to use a dissimilar metal, the cathodic metal should be either galvanized or cadmium plated to reduce the possibility of accelerated attack.
3. If dissimilar metal fasteners are required, passive stainless steels of the 300 series or of the 400 series (13% chromium or greater) are very satisfactory.
4. Gasketing materials such as neoprene, polyvinyl chloride, and most organic based coatings will prevent galvanic corrosion by insulating the two dissimilar metals. These materials should be non-absorbent.

In regular building construction, corrosion from galvanic attack has never been a problem. It is not expected to become one. In architecture, dissimilar metals are already used extensively. Most aluminum walls, for example, are attached with clips and bolts to the structural steel of the building without any problems from corrosion.

However, special problems can arise. For example, one kitchen where hams are cooked is a big barn-like room with steel girders, steel supports and an aluminum roof. The steam rises and condenses on the roof. Here the possibility of corrosion was eliminated by proper design and choice of alloy.

Corrosion today has a very scientific background but special conditions must always be given proper consideration. For example, Monel rivets are used to fasten airplane wings together. In seawater, Monel and aluminum form a strong galvanic couple. But in airplane wings, there is no problem. It is difficult to set up general rules. The circumstances under which the material is to be used are always the controlling factor.

We have been considering only that type of galvanic corrosion which results from direct metal-to-metal contact. Another source is the electrolytic deposition of cathodic metals onto aluminum from water which has drained off copper gutters and flashings. To protect against this source of corrosion, it is necessary to paint the copper parts.

CAN ALUMINUM BE PLACED IN OTHER MATERIALS LIKE CONCRETE WITHOUT FEAR OF CORROSION?

Aluminum can be buried in concrete without corroding. It is standard architectural procedure today. A slight amount of etching occurs during the setting period, with maximum depth of attack about .001-inch. If the aluminum happens to rest on steel reinforcements, some localized corrosion may occur during the setting period but again it will be of no consequence.

However, if an accelerator such as magnesium oxychloride or calcium chloride is added to the concrete, then it is possible for the galvanic action between aluminum and steel to continue. Consequently, it is recommended that accelerators be avoided where aluminum is involved or that the aluminum be coated with an inexpensive asphalt or tar base paint.

At times corrosion of aluminum can be initiated by contact with concrete, masonry or wood surfaces because such contacts will shield the metal from oxygen, thus preventing the natural repair of the protective oxide film. This attack can also be effectively prevented by applying an inexpensive, organic coating of a bituminous, mastic or asphaltic base material. Tar or asphalt impregnated building paper may be employed, but it is not as effective as the protective organic coatings applied directly to the aluminum.

Alkaline building materials, such as concrete and mortar, cause an etching attack on aluminum which affects appearance but does not structurally weaken the aluminum shape. This attack can be prevented by the use of stripable organic films or by the application of a clear methacrylate coating.

Although aluminum is inert when in contact with, or buried in, many soil types, there are conditions where corrosion may become a problem. The application of an inexpensive petroleum based organic coating will normally be satisfactory in preventing this action.

DOES CORROSION EVER ENDANGER THE STRENGTH OF ALUMINUM?

From an architectural standpoint, corrosion seldom, if ever, reduces the strength of an aluminum part. The critical factor is the thickness of the aluminum. For example, if foil of a thickness of .005-inch or less were to be exposed outdoors and corroded to a depth of 1 or 2 mils, its strength could be reduced appreciably. However, a section of aluminum ¼-inch thick, pitted to a depth of 1 or 2 mils, will not be affected either in strength or

longevity. All architectural aluminum, being of an appreciable thickness, thus is completely unaffected by such attack, as far as strength or longevity is concerned.

Of course, corrosion resistance is only one of the properties desired in a building material. Ease of fabrication and the ability to take a wide variety of permanent attractive finishes are also important factors. It is not a single property but a desired set of properties that must be possessed by the material.

WHAT IS YOUR BEST ADVICE TO ARCHITECTS AND ARCHITECTURAL ENGINEERS DESIGNING IN ALUMINUM?

Probably the best single piece of advice is to design within the properties of the material. By really knowing the properties of the extensive family of aluminum alloys, the designer can create a structure that will combine long life and economy. In studying corrosion, the original cost is only one of many factors to be considered. In selecting aluminum, the number of years added to the life of the building as well as the reduced maintenance must be considered. In bridges, for example, the difference in initial cost between steel and aluminum is little more than the cost of a single application of paint. So those large structures which require painting continuously offer important savings in maintenance when made of aluminum.

With the research and experience now available in the aluminum industry, the majority of corrosion problems can be prevented by the architect or architectural engineer at the design stage. The architect who feels free to ask for information when designing can be confident there will be little need to call for help when the building is under construction or completed.

For further reading on the subject of corrosion, see Bibliography, page 116.

RELATIVE COST OF ATMOSPHERIC CORROSION OF METAL ROOFING

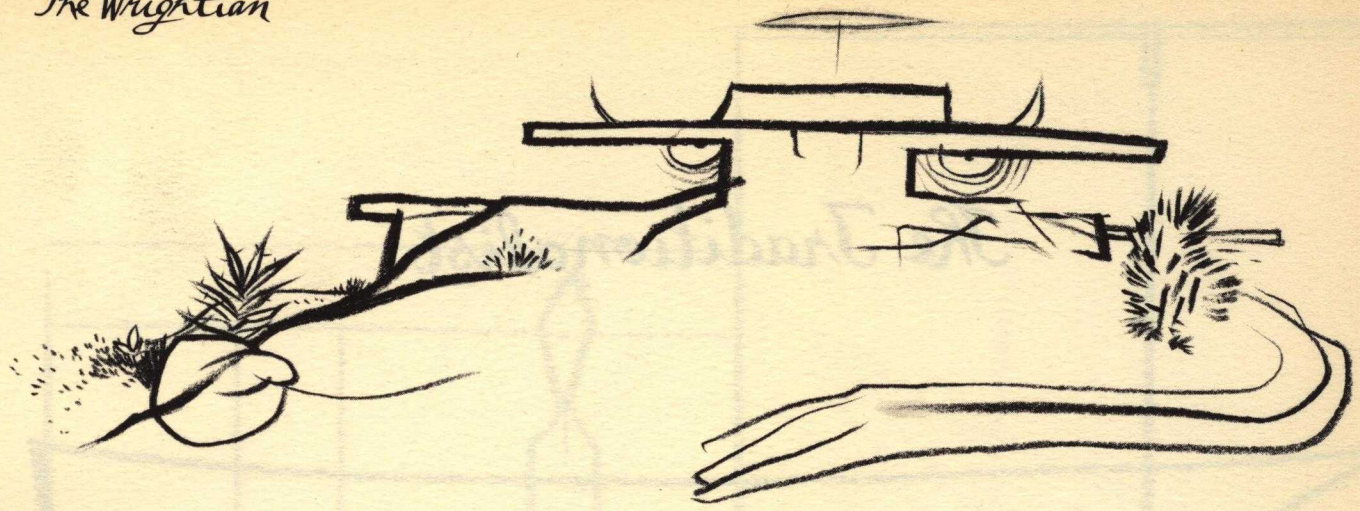
Metal Roofing Material	Thickness Inches	$/sq. ft.	Corrosion Rate – Mils/Year			Corrosion Cost – $/1000 ft 2/yr		
			Rural	Marine	Industrial	Rural	Marine	Industrial
Aluminum	0.032	0.20	0.0034	0.0125	0.0379	0.02	0.08	0.24
Copper	0.032	0.86	0.0157	0.0206	0.0531	0.42	0.55	1.42
Lead	0.085	0.64	0.0125	0.0207*	0.0151	0.09	0.16	0.11
Steel	0.018	0.04	1.5**	2.0**	5.0**	3.33	4.44	11.10
Galvanized Steel	0.022	0.11	0.0450	0.0237	0.281	2.74	1.44	17.11

* for La Jolla, California
** On a ten-year basis
*** Thickness of zinc layer is 0.0018″

$$\$/1{,}000 \text{ sq.ft/yr.} = \frac{(1{,}000)\ (\$/\text{sq.ft.})}{(\text{mils thickness})} \times \text{Cor. Rate (mpy)}$$

Note: Prices taken March 1958 from Reynolds Mill Products Catalog and from Reynolds Aluminum Supply Co. and Southern States in Louisville, Kentucky.

Corrosion Rates from ASTM Bulletin No. 175, 6/55

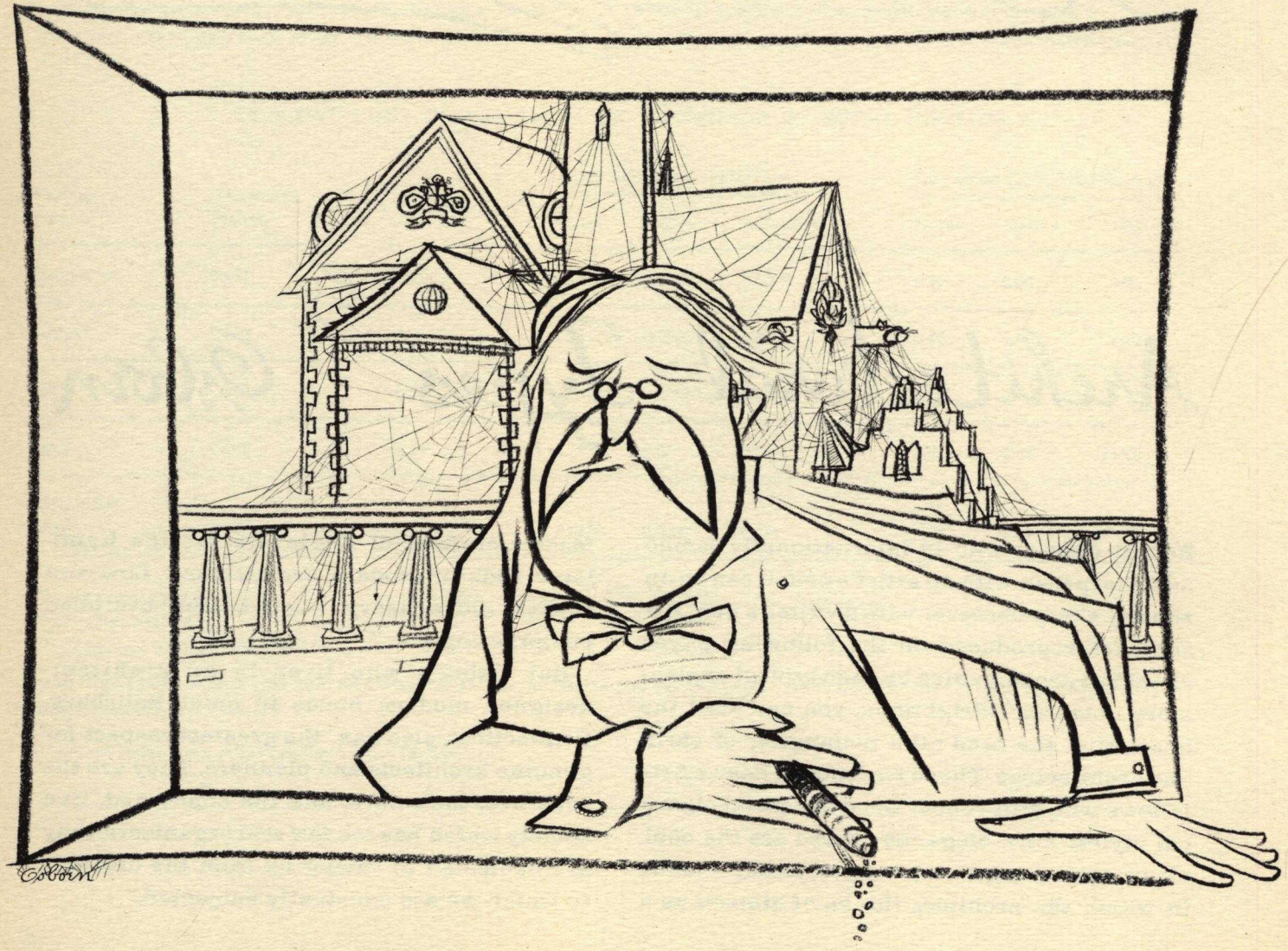


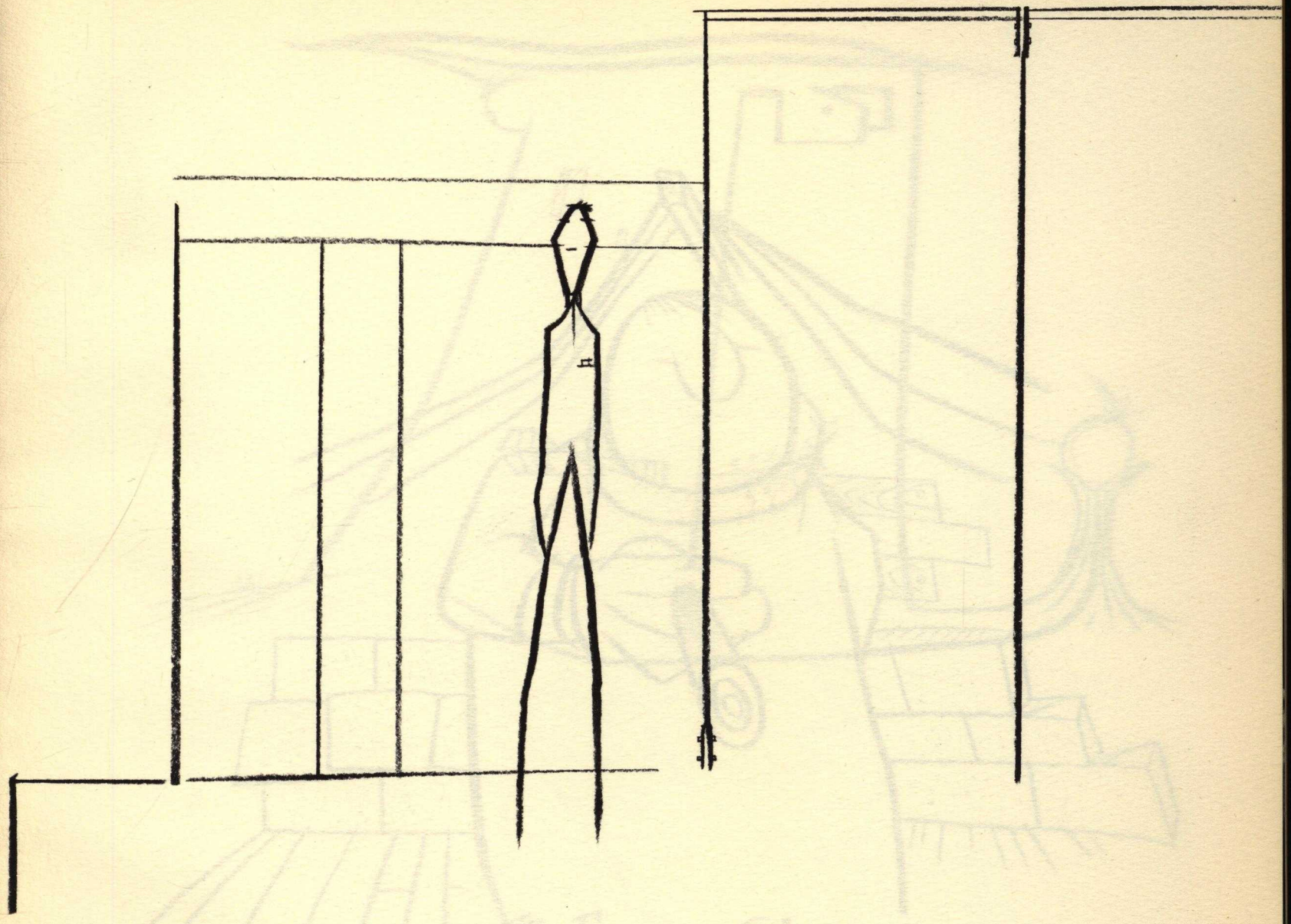
Architectural Types by Osborn

Robert Osborn who is internationally famed as a sharp man with an artist's pencil can be an equally sharp observer with a writer's pen. His sketches reproduced on the following pages should be accompanied by such typical explanatory notes as: "Wrightians, you can't tell the heap from the land—the melanging of earth and architecture. Those traditional Beaux Arts fellows who still repeat the declassical classical styles. Pure elegance—these are the cool, clean cats. Rough and tumble, costly jumble in which the architect thinks of himself as a Master craftsman! Engineers are the Kantilever Kids of modern architecture. Low and always those heavy wood beams overhead compressing you."

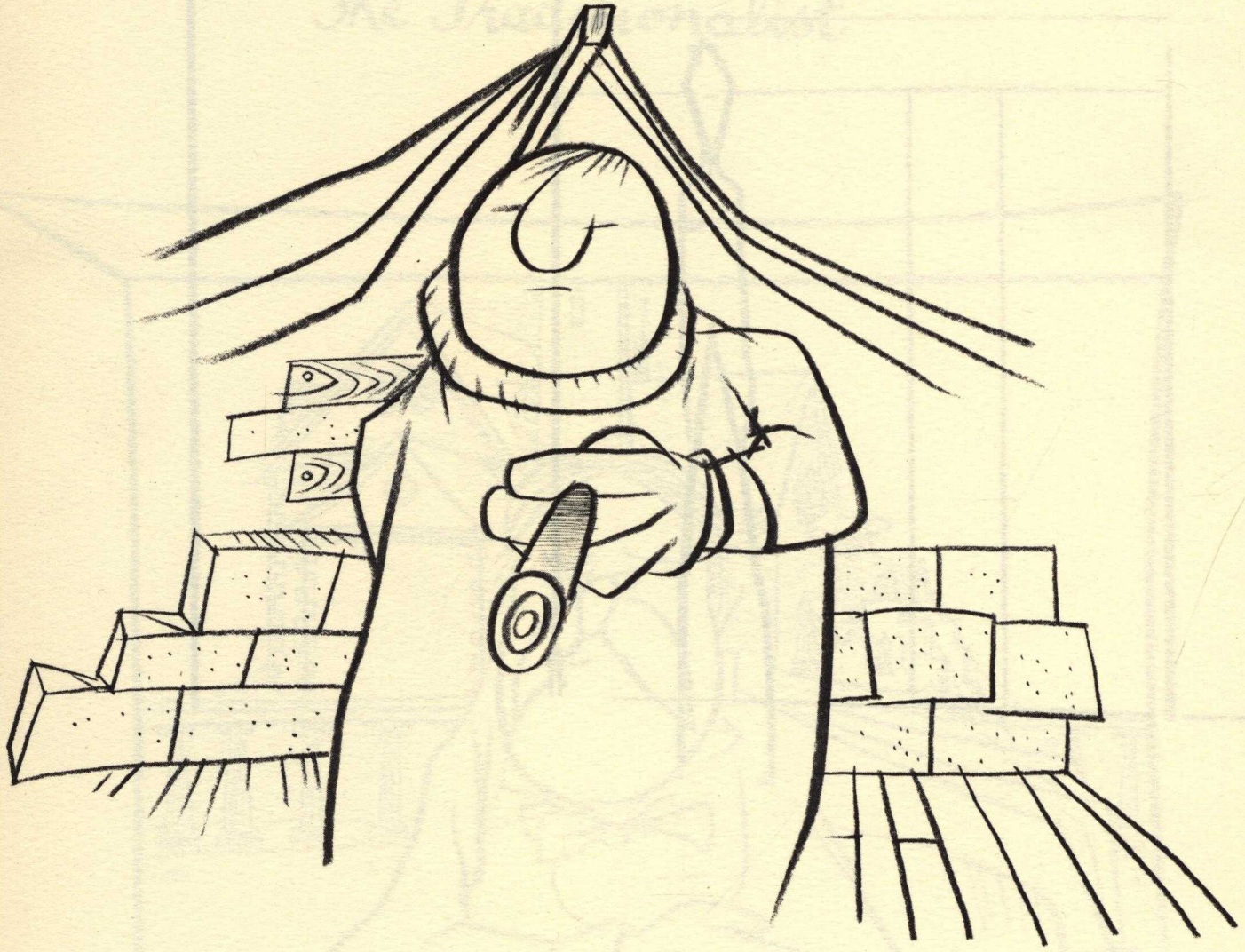
But Osborn who lives in an architect-designed modern house in quiet Salisbury, Connecticut, also has "the greatest respect for genuine architects and planners. They are the sensitive, the aware, and the concerned. In a society which has too few real organizers, they are dedicated to saving us from the disorder to which we are constantly subjected."

The Traditionalist

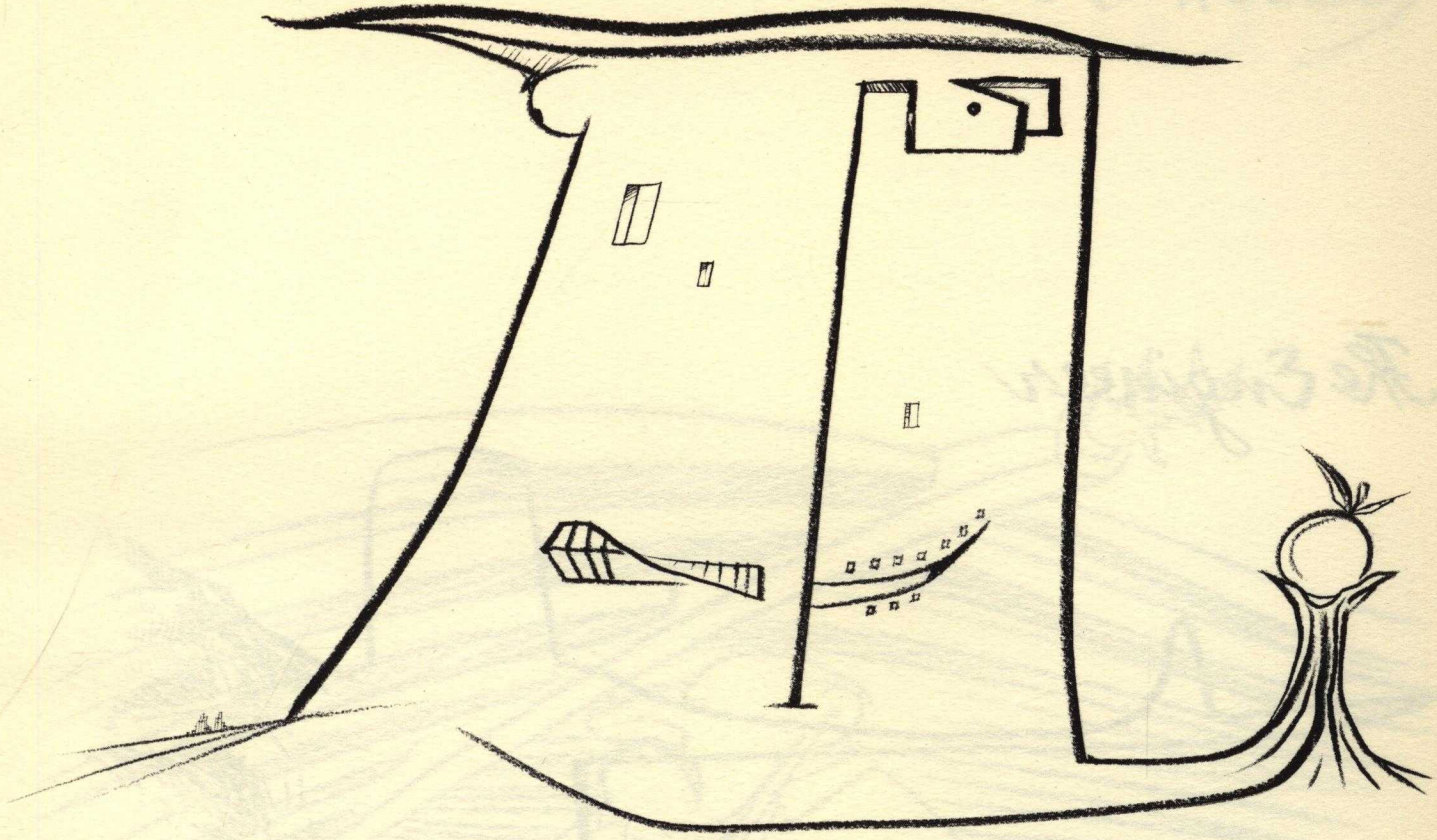




The Pure

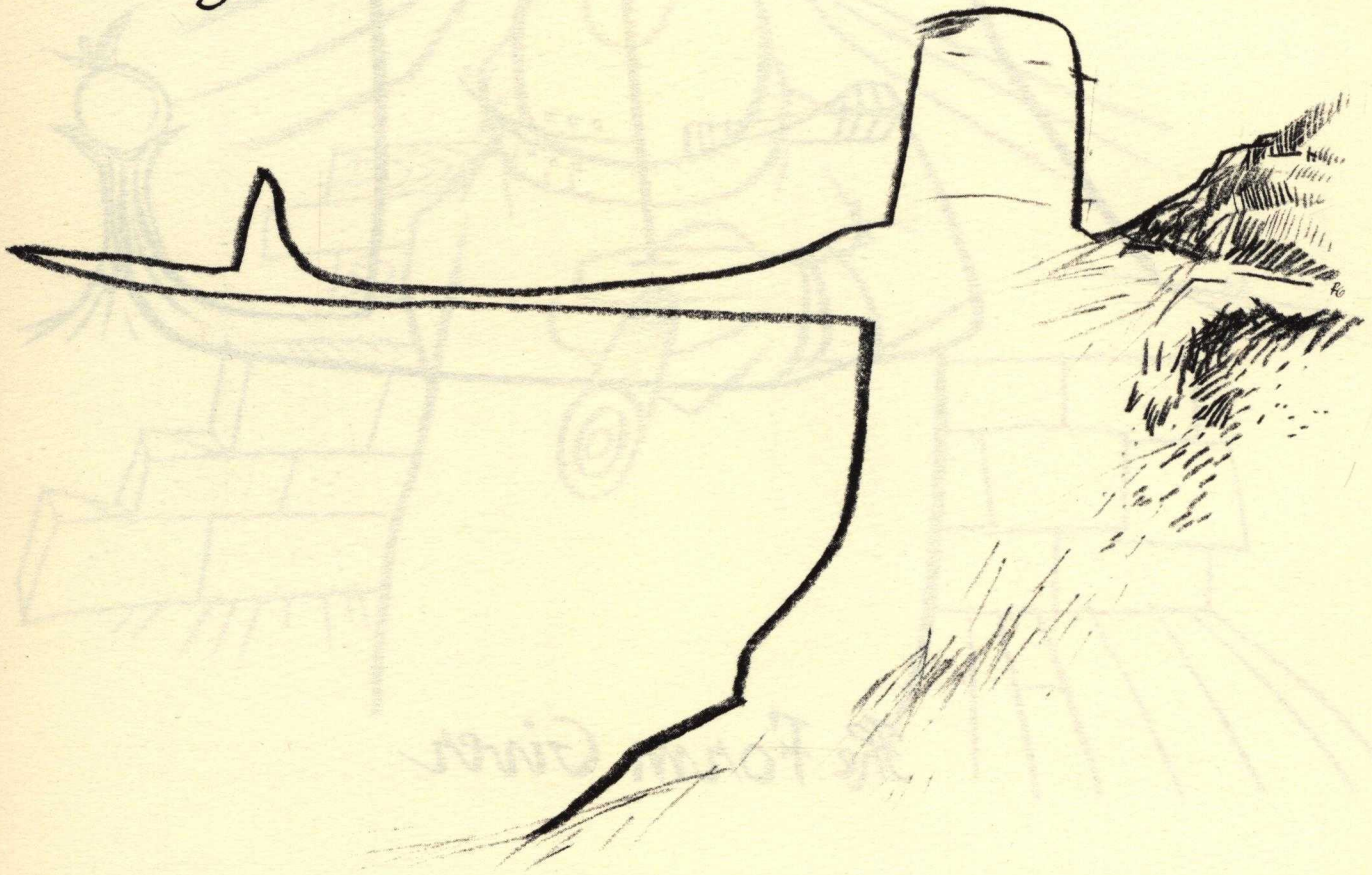


The Rough and Jumble



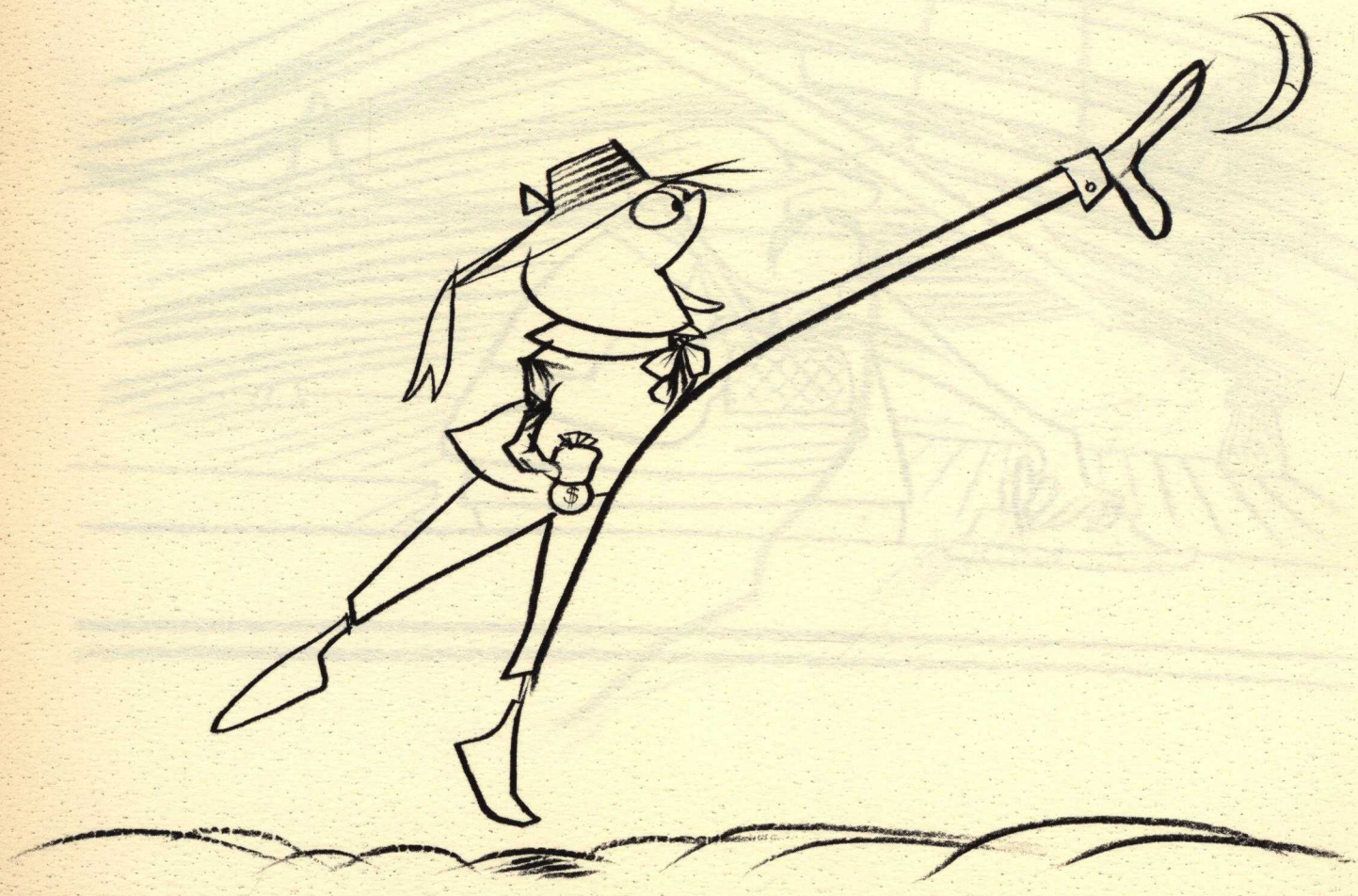
The Form Giver

The Engineer



The Woodsy

The Client



The Future of Aluminum and Modern Architecture

There is an old saw about those who can do, do and those who can't do, teach. Here and on the following pages are four men who head the Departments of Architecture in four leading American universities, who not only teach in an impressive fashion, but do architecture in a superb way—Paul Schweikher of Carnegie Institute of Technology (below), José Luis Sert of Harvard University, Paul Rudolph of Yale University, Ralph Rapson of the University of Minnesota. Known both for the remarkable quality of their work and the wide influence of their imagination, they here discuss in tape recorded interviews both architecture and aluminum.

José Luis Sert Dean of the School of Design, Harvard University – a pioneer in modern architecture of international renown.

"Aluminum is taking an increasingly important place in contemporary architecture. It looks its best when its qualities of lightness and strength are emphasized by the designer. When used in a curtain wall with glass and light panels, the curtain quality of the wall should be visually stressed. Aluminum should not try to imitate other materials. I do not like to see it used in big, box-like sections that look heavy and are more appropriate to materials of different weight and structural qualities. Past experience shows us that a certain time is required before any new material finds its right place and expression in terms of design.

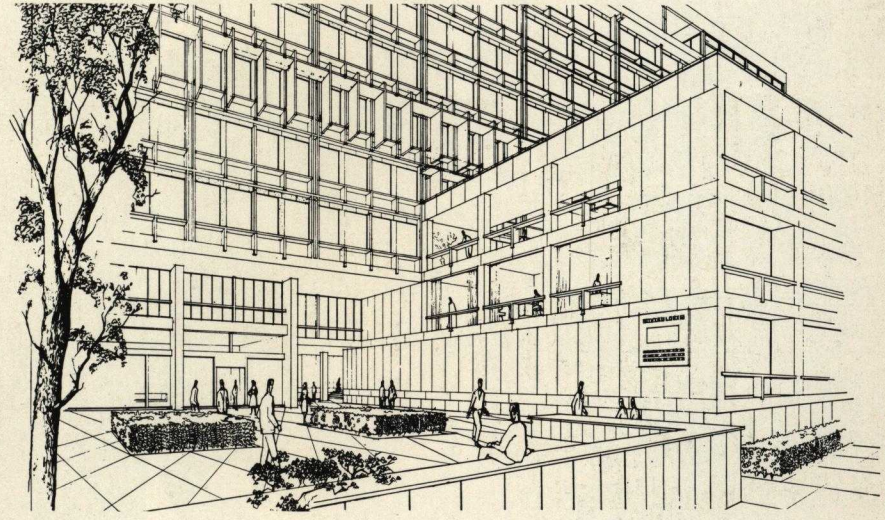
"I must say that I have seen no building designed in aluminum where aluminum has the quality that it has in aircraft design. I wish that some of the architects could really, in a happy moment, design a building where it would emphasize that kind of quality and not just be a translation of steel

Model shows details and facade.

or wood or anything else. I think this might change the look of buildings.

"Regarding color in architecture, there's color in nature everywhere. It's in the bird's feathers and the leaves of the trees. It is in all these things in addition to form, in addition to structure. Color still can live without destroying these other qualities.

"I have a certain approach to color that perhaps came to me through my friends who are painters–people like Léger and Miró. We have long conversations on the use of color. I generally like to use bright, pure colors in certain spots, emphasizing parts of the building against more neutral ones, like white or gray or whatever color exists because of the type of building . . . that's a personal approach, of course. I do like to use very strong color accents and



Sketch shows the south side of the Harvard Health Center and Office Building.

I think they can very easily be obtained in aluminum.

"The bright, brilliant pivoting panels in my house for instance, could very easily have been done in aluminum and they would work very well. As a matter of fact, they would be much lighter and better, easier to maintain. I always admire the tremendous doors of airplane hangars where very large movable parts work perfectly well with a material like aluminum.

"It is also ideal for sliding doors. That is one of its great applications. I think we are going to see more of aluminum in residential architecture. There's a rather healthy Japanese influence in this country. Sliding partitions and sliding panels, especially with the small-size apartments we have today, can do wonderful things. I remember I tried to design them far back in the late twenties when we didn't have the proper material. Everything was too heavy and got stuck or warped. Now it's very simple to have sliding doors in aluminum and they work very well. Aluminum is an action material, a material where mobility is inherent with the material.

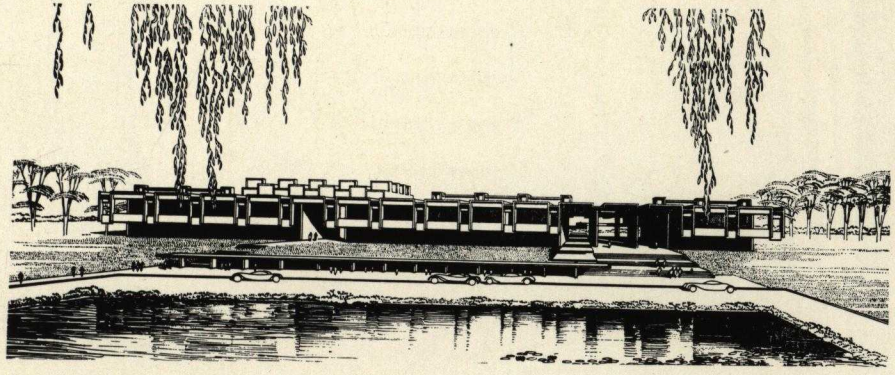
"Architecture is heading for enrichment of forms, but more especially toward developing what is basic in architecture–a new concept of the use of space. The shaping of space is always the basic thing no matter what time or history. In the end what really is important is what you can do with a material in terms of space, how it can be used in designing and shaping space."

Paul Rudolph Chairman of the Department of Architecture at Yale University – the younger generation's articulate spokesman for, and an active practitioner of, modern architecture.

"About the most difficult thing in architectural school is to have students think in terms of materials–what you do in one material as opposed to another. This takes a long time to even begin to understand, but I think it's at the very heart of the problem of architecture.

"One of the things we have done here at Yale, just this past year, was to give a planning assignment of a very simple building, one in which the plan was very unimportant, and ask for three different materials solutions. We didn't want any hocus-pocus about it. We wanted to know simply by observing what this building was made of. In any building that's worth anything, one does not have to be told what material it is. One can tell by its innate form.

"Aluminum works really well when you are moving something. We, in our practice, have tried to work out in aluminum and paper honeycomb core, a wall which would pivot at the top–horizontally. There the moving quality has meanings. In Florida, depending on how you feel, or the weather, you may want a cave or sometimes want it very open. My feeling is that quite often in that climate, the walls should quite literally lift up and become the overhang. It is, as a matter of fact, four things: number one, it is the wall; number two, it is the ventilating element; number three, it is the overhang; and number four, it is the hurricane protection.

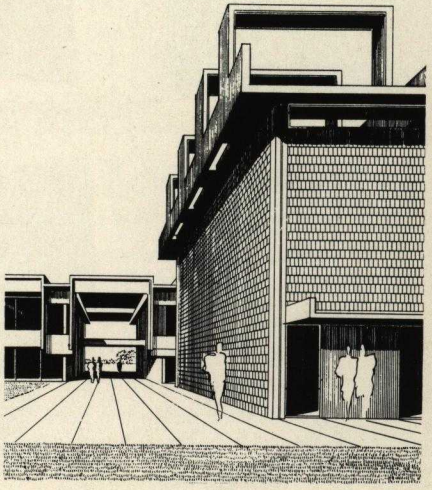


This drawing of the Sarasota High School, Sarasota, Florida, shows both Rudolph's unusual art abilities and his architectural skills.

"I'm also for color in architecture. But naturally, the question is how to get the most effect out of color. I think, strangely enough, by using the least amount of color, you usually get the most. Also there is the whole question of how you use color inside as opposed to how you use color outside. Also, in certain regions some colors and intensities work, whereas in other regions they don't. For instance, I quite often fly from Boston to Miami, and it's wonderful to see change in color. It has to do with the quality of the sunlight.

"I think every school should have a sense of direction. I don't mean by this that what the students do should reflect in any way what the head of that school himself might do. It's the principle of the thing that is important. We make a real effort to try to clarify not only what the three leading architects have done, but also what architects have done all through history.

"I am interested, you know, in the theory of architecture, as well as in practicing architecture. The two things are parallel, and it's important for me to stop every once in a while and try to assess what really is going on. Also, I find that talking about architecture with students is a very stimulating thing. Students quite often make you put into words things which you never get around to analyzing. I'm sure I get much more out of being connected with the school than any of the students do."



Typical Rudolph details are revealed in this rendering of Sarasota High School.

Ralph Rapson Dean of the School of Architecture at the University of Minnesota – noted especially for his important contributions to the residential field.

"While there has been wide acceptance of aluminum in recent years throughout the entire building industry, there has nevertheless been a noticeable lag in the application of aluminum in residential and housing work. Aluminum is a product of our technological era. In many ways, this explains the use-lag in residential work, for housing touches close to the individual. While people generally may accept technology in other types of buildings, they appear reluctant to accept metal as a finish material in their homes. Certainly, with further development, experience, and refinement of aluminum in terms of surface color, texture, and finish . . . with the continued exploration of the material in all its potential . . . the future importance of aluminum in residential housing is unlimited.

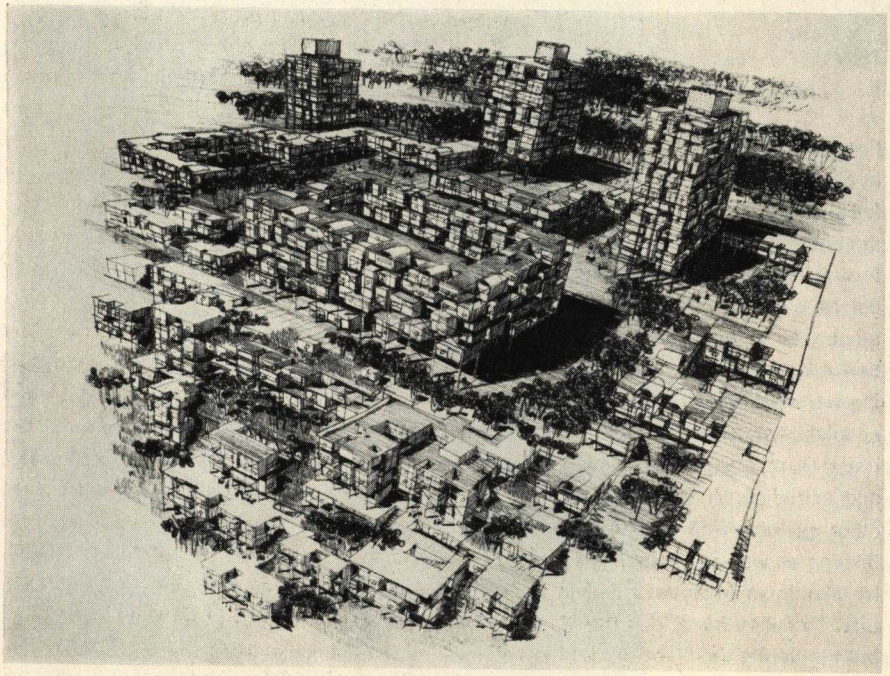
"From this standpoint, it seems to me that one of the directions of the future will be greater and greater use of industrialization as applied to home building. This means prefabrication. Whether it's prefabrication of the individual parts for site assembly or whether it's total prefabrication at the factory, it is difficult to say. Probably both of these things will happen.

"It is vital that we stop the senseless squandering of our natural land resources and have greater respect for our total environment. Perhaps we should begin to think of housing more in terms of the total space. This probably means group and multi-family housing. Not that I think we should rule out the individual house. The individual house can be with us, though as a part of a larger complex.

"I consider multi-family developments important. Certainly so in a city like Minneapolis and St. Paul. Here we're hemmed in by a complete chain of suburbs. The central city has no place to go, except to go up. This may not be a city involving really high-rise buildings. Apartment living hasn't been explored nearly as much as it could be in this country, especially as compared with some of the European countries where this is more or less the ideal of living.

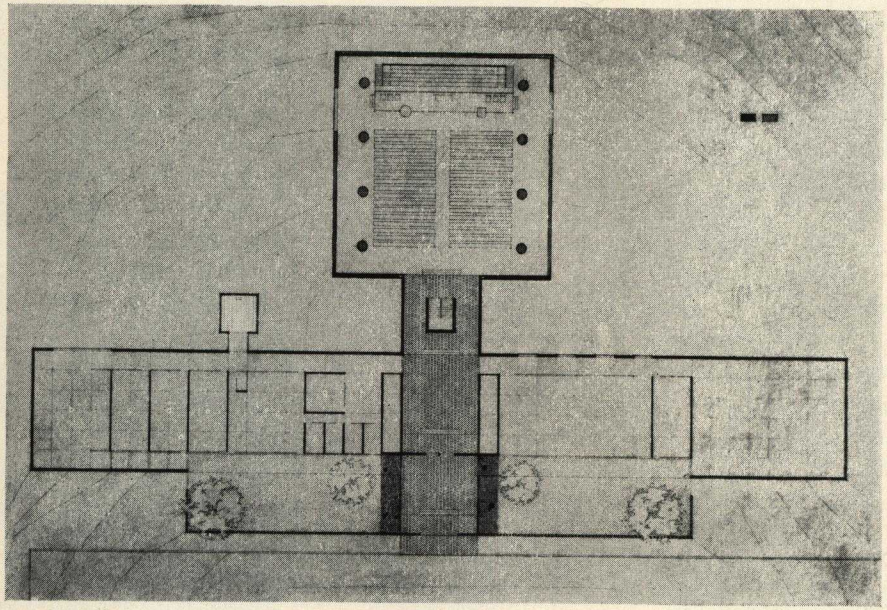
"Though we looked for an apartment when we came here, my wife and I now live in an old Greek revival house. We have torn the insides out and remodeled it. It's really quite an excellent house. It is the product of a builder, who years ago, went to the local lumber yard and selected stock parts. Then following the same formula which had been handed down through builder manuals, he came up with what I think is a very handsome old house.

"In a sense the curtain wall is something of the same thing. We'd hate to have every building a stock or formula type of building, but it does mean that we have a vocabulary from which almost anyone can pick parts, put them together and come up with a reasonable building. This certainly doesn't mean that we're going to have really great buildings, but it does mean that we will have a number of buildings of a relatively higher level of design. I think there's need today for more good component parts that can be put together with richness, variety, and interest."



Drawing of Riverside Housing, Minneapolis, Minnesota, indicates Rapson's housing ideas.

Paul Schweikher Head of the Department of Architecture at Carnegie Institute of Technology – with a wide reputation for buildings which exhibit an inventive and sensitive use of materials. (Photo on page 93)



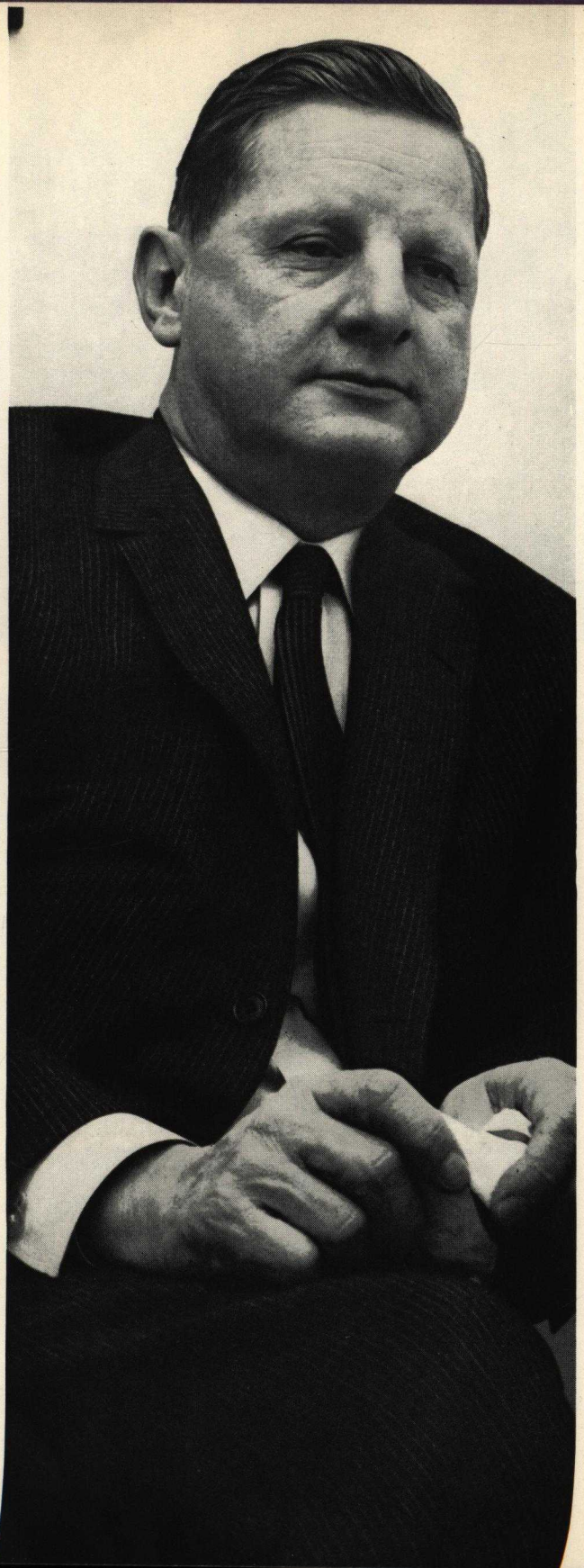
Floor plan for Trinity United Presbyterian Church, designed for East Liverpool, Ohio.

"I have little reputation as a prognosticator. Aluminum has a new place but I'm not sure that I have found it. I keep wishing for the opportunity to use it structurally. The structural shapes appeal to me a good bit more than the panels. Aluminum in structural shapes should be as important to the architecture as the rolled sections in steel. Here would be the direction I would think in which lightness as a property of aluminum would really become important.

"I can see that if you use this particular quality of lightness, that it must bring along with it not only a demand for lightness but a whole aesthetic of less weight. I don't think that lightness is automatically a good quality, but it promises new directions. The significant future for aluminum–in all building, houses as well–will be in a full use of all of its virtues: its lightness, strength and durability; its variability of texture and of color (the metal's own) or colors, such as enamel for which there is a special affinity; characteristics of insulation and conduction; tactile effect, including warmth to touch; most importantly, its adaptability to changes in form by bending, breaking, rolling, cutting, casting, pressing, and extruding. A synthesis of these and other qualities with structural uses (load-bearing as well as enclosing) is the future for aluminum in houses and in architecture. To date a few efforts have been made but they seem timid and without direction. Aluminum interests me in that the square corner can be so quickly and easily possible. It lends itself to a precise use of the material. Metals can be handled precisely. They can be molded precisely. They can be made and milled precisely.

"I think my own reaction is as simple as this. Right or wrong, I like materials for what they are and as they come. This can mean as they come out of the tree in the forest. It can mean as they come off the mountainside in rocks, but it can also mean as they come off the end of a lathe or out of the mouth of an extruding die or out of the blast furnace. If that is a naive way of looking at it, I can't see differently.

"You've asked about present-day architecture. All of us see architecture all around us. The profession is a busy one. Architects everywhere are busy signing their names to things, building buildings. But only a few are practicing with a caring eye. Many care for utility and cost but only a few care for visual qualities. There is a careless disregard for form, order, even for good usage but these are the essential parts of all architecture no matter how commonplace they may seem to be. There may not be rules for proportion or scale but there are principles of form and order and all architecture must follow at least good usage. Good usage in literature regulates tenses, syntax, conjugations, modifiers; it presents thought in an orderly way; gives form to the composition. Good usage in architecture can be as helpful. All architecture cannot be great architecture. Much of it may not even be very important but all of it, if it begins with good usage, can have an order; the promise of good form."



Aluminum in Modern Housing

by Albert M. Cole

Former Administrator, Federal Housing and Home Finance Agency; now Executive Vice President, Reynolds Aluminum Service Corporation.

Better materials and products do not assure better architecture, better building or better houses.

These must be assembled, just as other products, into a whole that people want – a home that will provide more opportunities for greater pleasures in living.

Design is the key to acceptance of new materials in meeting the needs of the people.

The future will provide tremendously expanded opportunities for designing houses with new materials. Forecasts of an upsurge in demand for new housing are supported by increases in family formations and an effective home building industry supplemented by the emergence of increasingly energetic building products manufacturers.

Today, while recognizing housing as an important factor in our economy, many people, even architects, under-estimate its magnitude. For example, the housing industry accounts for 21 percent of our gross national product. Frequently, the automobile is used as a criterion of the health of business. But if repairs, maintenance, and operating expenditures are added to purchases, the impact of housing upon the economy is three times as great as that of autos. (*)

In addition to brick or mortar money spent on new housing, every sub-division means money spent for telephone lines, sewer and water lines, streets and highways, churches, schools, shopping facilities, plus 40 billion dollars per year spent to operate existing homes.

Another financial bench mark is obtained by an examination of the nation's consumer credit status. The mortgage debt on housing (1957) amounted to 108 billion dollars, as compared to 45 billion on all other consumer goods.

Translated in terms of people – more than a million families each year move into a newly constructed home, while millions of others are busily rehabilitating existing houses.

The healthy energy of the American home building industry, combined with the great desire and ability of the housing con-

(*) Source of Federal government statistics: 1958 Housing and Home Finance Agency staff reports to the Administrator.

sumers, is augmented today by the housing programs of the Federal, as well as state and local governments.

I shall describe the Federal programs, as an example to illustrate the magnitude of these governmental agencies.

The Housing and Home Finance Agency is the largest. It has five agencies, dealing with home mortgage insurance, secondary mortgage market, urban redevelopment aids, community and educational facilities assistance, and low rent public housing.

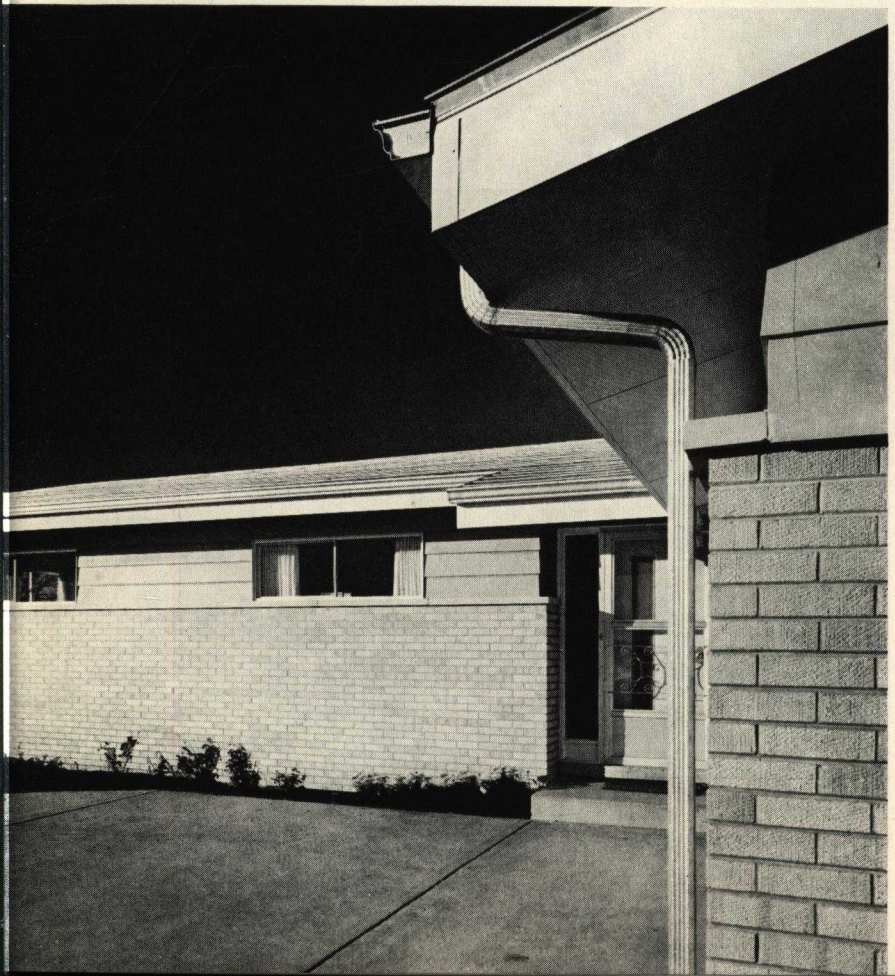
The Home Loan Bank Board supervises and aids the savings and loan industry. The Veterans Administration guarantees home mortgages for veterans. The Department of Agriculture assists farmers through the Farmers' Home Administration. The Department of Commerce provides basic statistical services, and its public roads program has a definite impact on housing. The Department of Labor gathers and publishes home building activity data, while the Department of the Interior's programs of water supply and control, together with its parkway roads systems, are related to housing. The Department of Health, Education and Welfare touches housing in at least four of its programs – environmental sanitation, educational facilities, water pollution control, and hospital and health clinics. Lastly, the Small Business Administration provides loans for homes destroyed by disaster.

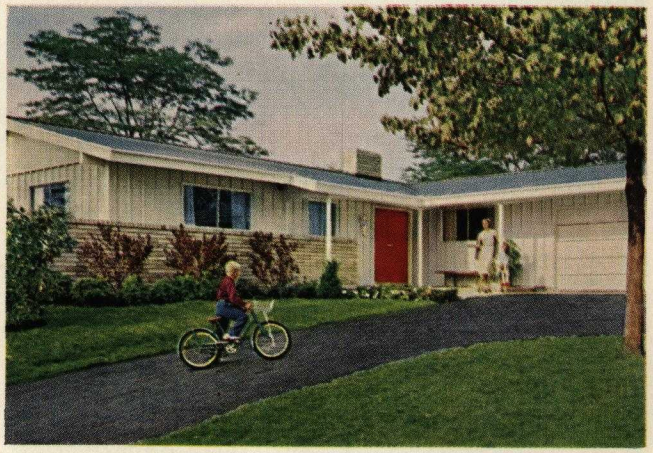
A list of the Federal housing programs discloses their vastness and complexity. But let us focus a little more closely on one agency to gain perspective. The Federal Housing Administration is one of five constituents of the Housing and Home Finance Agency. Among its programs are: insurance of mortgages on one- to four-family homes, both for sale and rent; on multi-family rental projects; on low-cost housing in outlying areas; on co-operative housing; on mortgages containing special provisions for disaster victims; on mortgages for properties, new and existing in urban renewal areas; on mortgages designed to aid relocation of families displaced by governmental action; on mortgages for servicemen and military housing; on homes for the elderly; and finally, insurance of home modernization loans.

I am informed that a 21-million-dollar-a-day business is common at the Federal Housing Administration.

Now, we turn to the Housing and Home Finance Agency, the "parent" of the Federal Housing Administration.

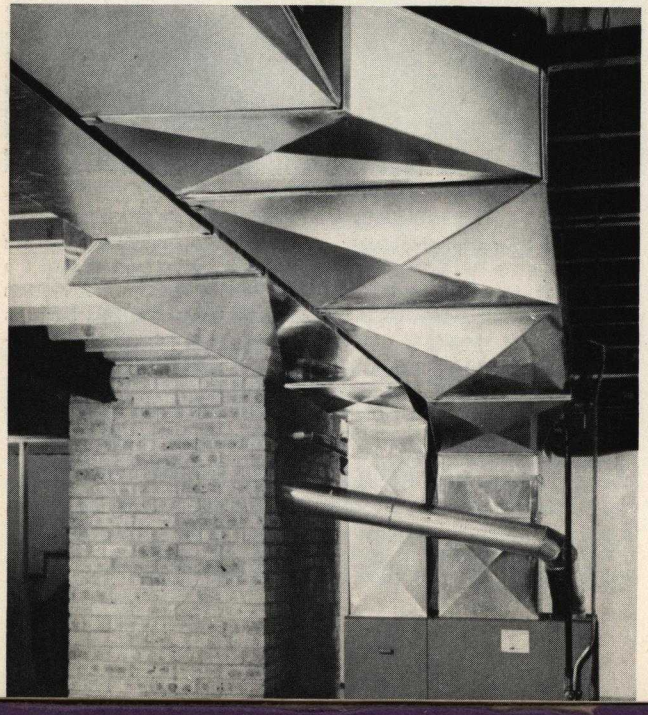
The budget submitted to Congress by the Housing and Home Finance Agency is the most complex of any department or agency in the Federal government. The housing agency insures and guarantees, lends and borrows – it buys, sells, rents and gives away real and intangible property – it subsidizes and makes grants which are either repayable or cancellable – it issues notes, bonds, debentures, common and preferred stock. It receives

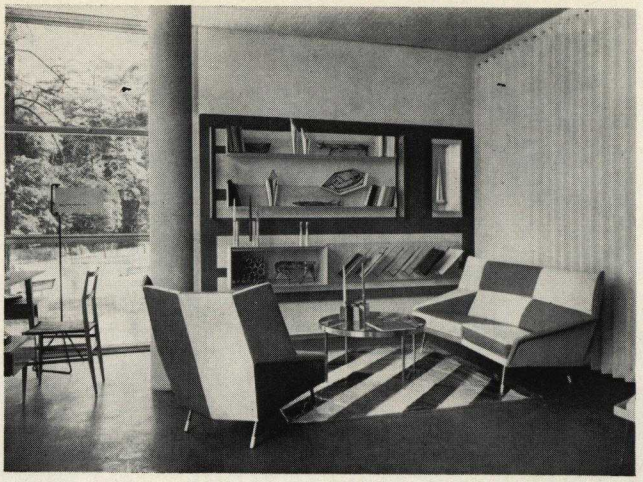




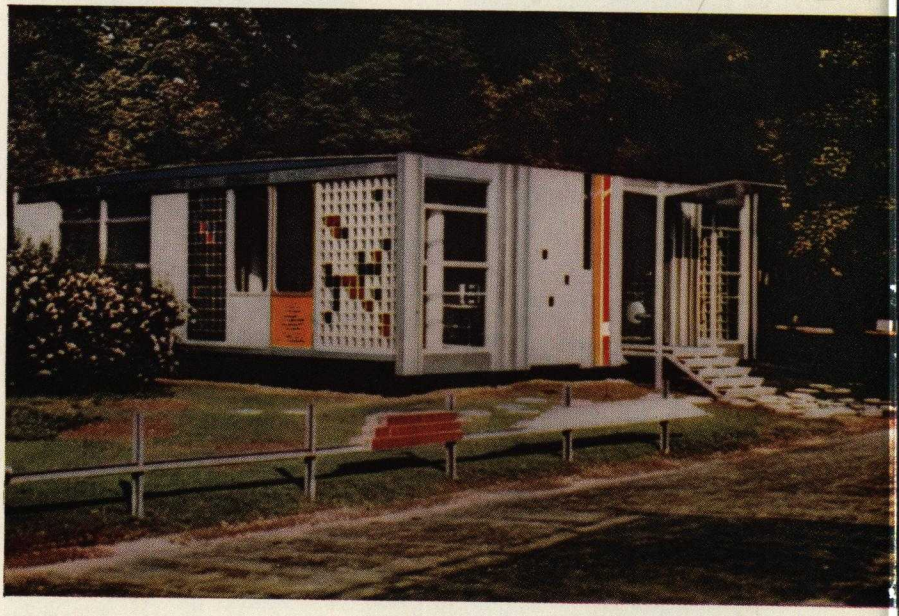
Top One of the most important aluminum advances in the last few years has been in the residential field. The often-predicted adoption by the housing industry of the materials and methods of modern industry has occurred with suddenness and unprecedented success. This home in California contemporary style is produced by the nation's largest manufacturer of prefabricated houses, the National Homes Corporation of Lafayette, Indiana. The view from the terrace shows not only standard aluminum sliding doors, but the new aluminum siding and roofing which represents "a major breakthrough in modern home construction". **Above** The easy combination of traditional building materials with modern aluminum components distinguishes National's Viking line. This chateau model used over 2,000 pounds of factory-finished aluminum in contrast to about 40 pounds in conventional building. **Left** This "House of Ease", by Wright Homes, Inc., in its Beverly Hills subdivision in Villa Park, Illinois, features aluminum roofing, siding, gutters, and down-spouts.

Above The handsome aluminum kitchen units in this aluminum prefab house were styled by modern furniture designer, Paul McCobb. **Below** Ductwork in this "House of Ease" in Villa Park, Illinois, delivers over 15 percent more heat and will never rust due to moisture condensation. It is typical of the many "hidden" aluminum products for home design such as insulation, wiring, and vents.

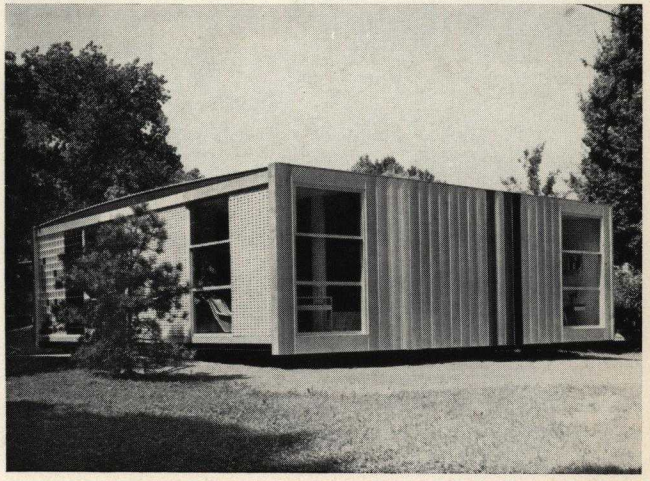




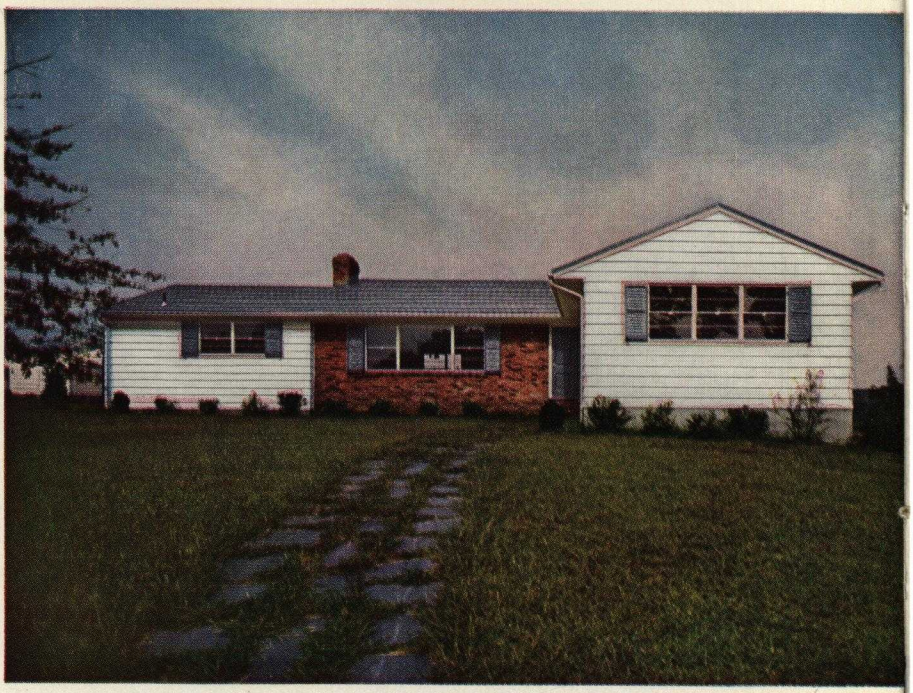
Above The aluminum housing unit designed by Italy's renowned architect, Gio Ponti, for Milan's XI Triennale Exposition, demonstrates some future opportunities in mass produced aluminum residences. Aluminum walls with built-in aluminum bookcases and specially designed aluminum furniture are shown in this interior. **Below** Exterior of this demonstration structure shows the variety of window and wall panel units.



Above This beautiful house for the Donald Millers of Chappaqua, New York, was designed for a dramatic woodland site by architect Edward Larrabee Barnes. Warm woods are combined with modern design to create an attractively romantic and remarkably functional home. The architect feels that aluminum sheet not only provided an economical, trouble-free roof but one ideally suited to the character of the design. Though this was a custom designed home, he could see future possibilities in such pitched roof units, prefabricated complete with aluminum soffits and window frames. Such large size factory-built components would provide the custom and tract builder with many of the construction benefits of mass production without loss of important design flexibility. **Right** Back view of the Ponti designed housing unit shows its prefabricated construction. This lightweight, self contained unit is designed to be joined side by side for low-cost row or court housing or stacked one on top of another for multi-story apartments. It indicates that aluminum engineering and manufacturing principles such as those now utilized in curtain wall construction for large-scale buildings could be applied in an imaginative fashion to housing. It would result in revolutionary construction speeds and economics.



Above Both vertical and horizontal aluminum siding are used in the carport of this Wilmington, Delaware, "House of Ease" designed by architect Theodore Brandow for Franklin Builders. Leon Weiner, President of Franklin Builders and National Director of the National Association of Home Builders, appreciates the maintenance-free advantages of aluminum building materials.



Above Using many of the over thirty aluminum products designed for home construction, this "House of Ease" by architects Harsen, Johns & Kobayash, for Middletown Builders, Inc. in Middletown, New Jersey, emphasizes economy and low maintenance. Lightweight aluminum siding with a baked-on lacquer finish provides the homeowner with a wide range of tested colors in a clean, easy-to-maintain finish. Precise cutting and freedom from warping provide the builder with a more sound and speedy erection. **Below** National Home Company's Viking Model features this large, well-proportioned living room with a comfortable look. The modern aluminum roof will withstand a snow load 50 feet deep and resist hurricane winds. Snug aluminum walls, storm-tight aluminum windows and foil insulation assure the occupants of economical year-round comfort.

appropriations from Congress, and may draw upon the Treasury for certain authorized funds.

These are staggering, complicated programs. To administer them a Department of Housing and Urban Affairs will receive more and more favorable consideration.

When we add the activities of state and local governments to the programs of the building industry, combined with those of the Federal government, we now begin to understand the abundance of opportunity for designing houses with new materials.

There seems no reason why a high annual volume of new dwellings of sound quality cannot be sustained. Employment is at an all-time high, and prospects for continuing high employment are generally recognized as good. Family incomes continue to rise. In spite of increasing costs, real income of families continues to grow. This indicates that savings will be available to finance new construction. The market for housing will not be limited to newly formed families, but will include present households who want and can afford a higher standard of housing.

Whether new houses are built or the quality of existing ones is improved, new building materials will be a major factor in the modern house. Industry is recognizing this vast potential in the housing market. Particularly impressive are the research programs fostered by the National Association of Home Builders, the Lumber Dealers Research Council and other industry groups, working with building products manufacturers. Equally impressive are the product development projects of the manufacturers, especially those with new materials which demand new concepts in their use. It would be difficult to find a better example of this than the lightweight building material, aluminum. The aluminum industry not only has a tremendous interest in housing but is rapidly becoming a dominant factor.

Aluminum is considered a new material. Yet in a short period of time its acceptance has been rapid and widespread. This is because it meets human requirements and the demands of the designers, architects, engineers and builders.

In the home building field people want houses that are easy to maintain. They seek materials that are resistant to corrosion and do not have to be frequently repainted. Most homemakers want materials that do not absorb and pass into the house the hot rays of the summer sun.

Splendid examples of adaptation of design to meet the needs of the people are found in the "Carefree House", National Homes Viking line and the "House of Ease". Here standard building materials have been translated into aluminum. The resulting benefits have been so considerable that a major prefabricator describes it as "the greatest advance in housing in a hundred years".

We may predict, however, that we are only at the beginning of the use of aluminum in building design and construction. Laboratories, research projects and drawing boards are replete with new and exciting promise for growth.

The Solar House IV, research project of the Massachusetts Institute of Technology, is one case in point. "While solar energy is not yet in a position to compete fully with present sources of heat power," the University report states, "the heating of buildings with solar energy comes fairly close to being economic today."

An essential part of Solar House IV is an aluminum roof. Thus, one example of tomorrow's house expands the use of today's increasingly popular roof, by employing not only its lightweight, maintenance-free, and weatherproof properties, but also the advantage of its heat transfer properties.

However, individual free-standing dwellings represent only one type of housing. Attached houses with modern courtyards and patios have a growing appeal in areas where design is increasing rapidly. Multiple dwelling apartments in urban and even some suburban areas are being built at three times the rate of three years ago. Moreover, the character of these apartments is changing from uniform and tasteless cubicles to fully air-conditioned, balcony towers set in a park-like atmosphere around a swimming pool or boating basin for the exclusive use of the tenants. The apartment of the future promises to actively compete with the attractions of the house in the suburbs.

The application of aluminum construction techniques such as the lightweight curtain wall to these buildings as well as the prefabricated house will represent one of the great housing developments of the 1960's.

In Europe we see the development of self-contained aluminum dwelling units. The experimental aluminum house exhibited at Italy's famous XI Triennale is one example of units that can be stacked one upon another to create small apartments, or alongside one another to form what we might call row houses. We may expect many new forms like this to evolve – forms quite different from familiar ones based on the properties of familiar materials. In this sense we may say that aluminum is not only a material of the present but of the future.

The aluminum industry is awakening – as are other manufacturers – to the realization that better architecture – better buildings – better homes must provide more opportunities for greater pleasures in living.

Design, therefore, becomes the key. Architects with an appreciation of modern building methods and modern building materials and, above all, human needs are offered today an unparalleled opportunity in the field of residential design.

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